MODERN PLASTICS

NOVEMBER 1945

Plastics progress sails along on molded hulls

Co-Ro-Lite, a Durez-resin-impregnated sisal fiber, has been noted as a plastic material of tremendous strength with unusual adaptability to large moldings That the Columbian Rope Company, producers of Co-Ro-Lite should successfully develop a sailing boat with a hull molded of this material seems a logical step forward in plastics progress . . typifies the foresight and progressiveness of the industry as a whole.

The development of this Co-Ro-Lite sailboat is an outgrowth of the Columbian Rope Company's wartime experience in making large moldings such as jettison tanks, glider noses, and engine nacelles. The experience gained in molding these items seemed to be applicable to fashioning a strong lightweight sailboat hull.

Molding The Hull

To mold the hull, a thick blanket of rope fibers was first cut into a rough shape resembling the finished boat. This blanket was then mechanically dusted in a vibrator machine with a powdered Durez phenolic resin to the extent of 50 to 55% content. This combination was then bag-molded into the finished hull. The deck was molded separately but in a similar manner.

The inherent properties such as durability, moisture resistance, and impact strength which the Durez resin used for this purpose possesses, combined with the tremendous strength of sisal fibers, make a lightweight hull of unusual durability... a hull with no ribs or internal bracing.

Many Advantages

In addition to the production economies which Co-Ro-Lite effects, this Durez-resin-impregnated sisal fiber sailboat has no seams to be caulked. Furthermore, the monocoque construction provides a boat which does not have to be worked over each season aside from painting, and offers a clear interior with no ribs to catch dir Besides this, submersion tests ducted in Florida waters prove plastic boat resists penetration by b nacles and other growth.

Competent Assistance Availabl

The Co-Ro-Lite sailboat is but one of many highly successful developments in which Durez phenolic plastics were used.

As specialists in the production of the versatile phenolics for the past quarter century, Durez technicians have acquired a rich background of successful product development work. The benefits which this background and a wealth of proved data can provide are available to you and your custom molder at all times. Durez Plastics & Chemicals, Inc., 2611 Walck Road, North Tonawanda, N. Y.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB


Here, an ingenious
Oxygen Pump
housed in
Catalin
The Gem of Plastics
vies with the fascinating colors and
natural beauty of a tropical pool . . .
encases the medium that breathes the
essence of life to the aquarium's fleet-
of-fin occupants . . . keeps the water of
their habitat clean, freshly filtered and
crystal-clear.
Simple, highly successful techniques and
cost-favorable factors for casting this
and various other types of custom hous-
ings present advantages that are equally
as product-wise as the resultant un-
matchable rich color effects — and
regardless of whether the projected
production is large or small, they do
much to commend and extend the use
of Catalin in all fields.
This is the opportune time for manufac-
turers and their product designers to
become fully Catalin informed. Inquiries
invited!
CATALIN CORPORATION
ONE PARK AVENUE • NEW YORK 16, N. Y.
Cast Resins • Liquid Resins • Molding Compounds
This Air Pump manufactured by the Mon-Sew Corp.
is exclusively distributed by the Aquarium Stock
Co., New York

Modern Plastics

AND PLASTICS

★ ★ ★

NOVEMBER 1945

VOLUME 23 NUMBER 3

General Section

Plastics-Engineering Section

Technical Section

News and Features

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BRANCH OFFICES: 221 N. La Salle St., Chicago 1, Ill., 815 Superior Ave., Cleveland 14, Ohio, 427 West 5th St., Los Angeles 13, Calif.

ABC

Member Audit Bureau of Circulations

..suggest broad general uses for Geon

Possibilities include luggage, cameras, footwear, packaging and upholstery materials, and many others

DUE to several particularly nasty kinds of mildew, leather cases for binocular and other delicate optical instruments literally fell apart after a few days in the South Pacific early in the war. Then corrosive salt air or the humid air of the jungle got to the instruments and quickly ruined them.

That was soon corrected, however, thanks to the kind of cases you see in the picture. They are made from GEON polyvinyl materials combined with a reinforced plastic core. Mildew—even the meanest kind—has no harmful effect. Salt air or steaming jungle temperatures leave the GEON unchanged. The cases are waterproof and wearproof. They last indefinitely.

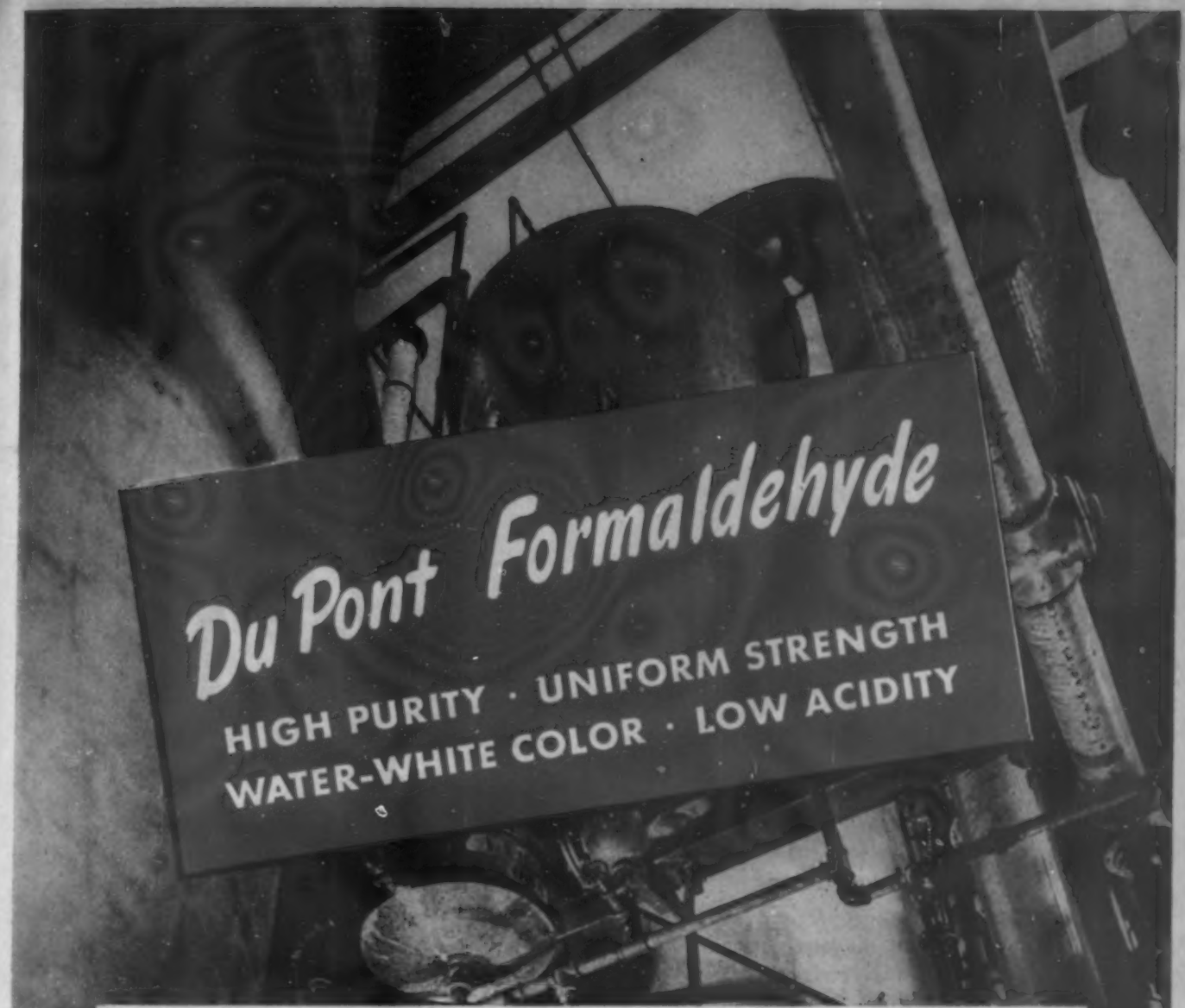
Just these few properties of GEON suggest many interesting and important applications. Scuff-resistant, good-looking, practically indestructible luggage and brief cases; upholstery material that can be left outdoors because it is highly resistant to weathering; water and mildew proof fabric coatings for rainwear, shower curtains, tents; soles and heels that will outwear leather many times; film, sheet or coatings of GEON for packages that will resist wear, aging, chemicals, foods, tobacco, oils and greases, moisture, heat and cold. All products made from GEON may be brilliantly or delicately colored.

There will be applications for GEON in every industry in America. For more complete information write Department II-11, B.F.Goodrich Chemical Company, 324 Rose Building, East 9th and Prospect, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY



DU PONT FORMALDEHYDE is produced under rigid control and supervision. The product is designed to meet the high requirements of the plastics industry.

AVAILABLE NOW for immediate shipment in the quantity you need!

SHIPMENTS in standard containers are made from the factory or stocks maintained in principal cities.

DEPEND ON DU PONT also for: PARAFORMALDEHYDE—powder or granular 95% minimum strength. And HEXAMETHYLENETETRAMINE—U.S.P. crystals or technical. Call our nearest district office for information and technical assistance. Electrochemicals Department, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

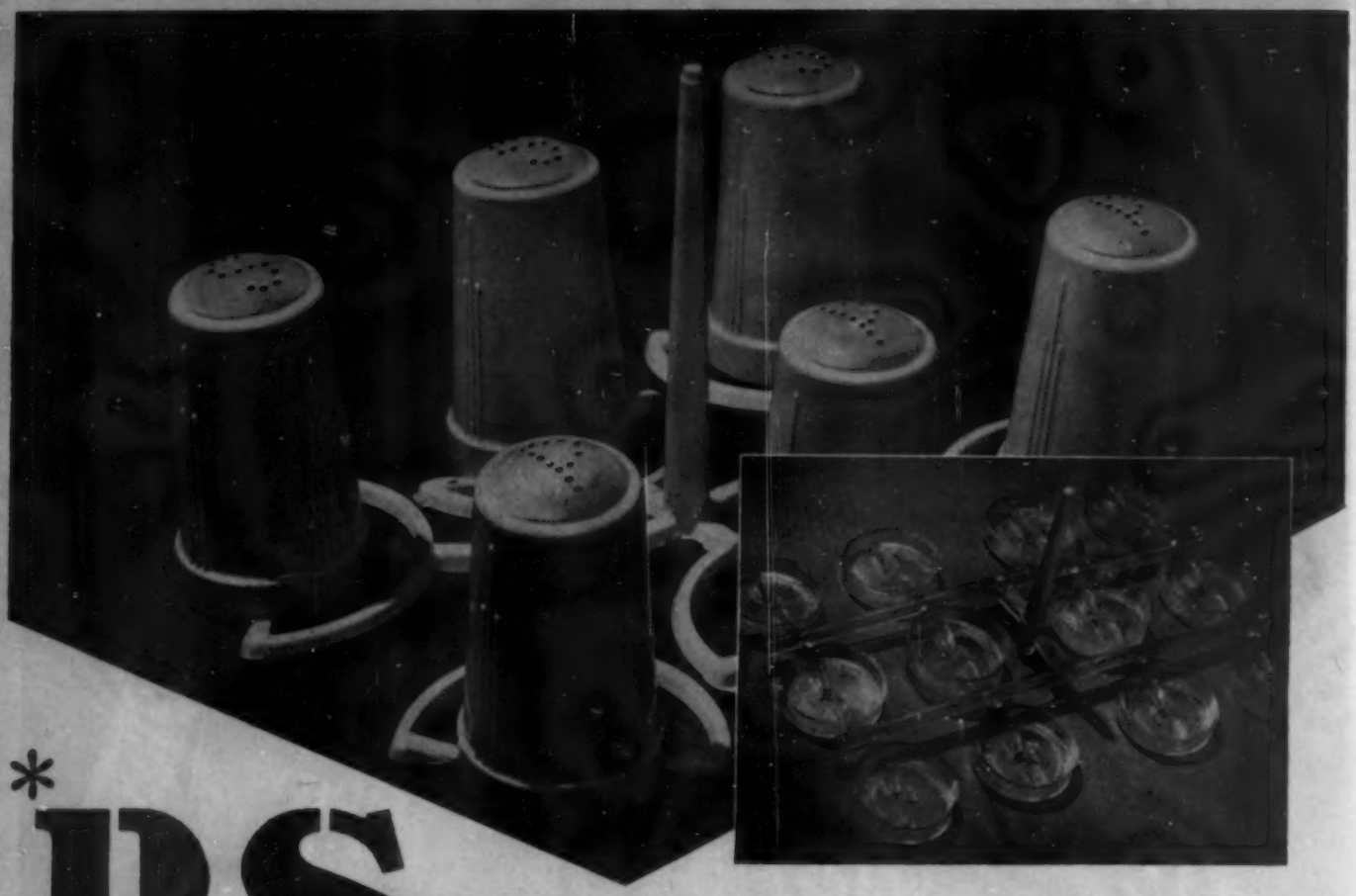
District Offices: Baltimore, Boston, Charlotte, Chicago, Cleveland, Kansas City,* New York, Philadelphia, San Francisco. *Barada & Page, Inc.*

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

BUY AND HOLD VICTORY BONDS

DU PONT ELECTROCHEMICALS



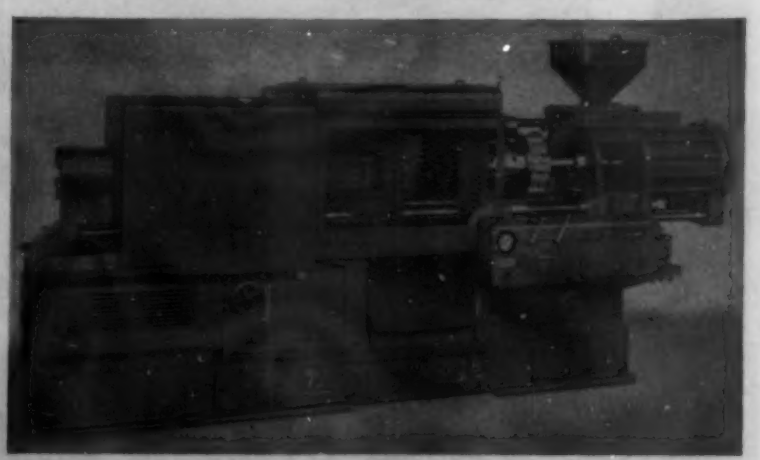
*P.S. and we don't mean postscript!

These large size pepper and salt shakers, 3½" high by 2" dia. at the base, weighing 8 Oz., illustrate the **Plastic Supremacy* achieved by users of Reed-Prentice Injection Molding Machines — producing an attractive kitchen accessory for every-day use — quicker, cheaper and better!

At the new and modern plant of Modglin Co., Los Angeles, Cal., equipped with Reed-Prentice Injection Machines — these styled shakers are molded on a 45 second cycle from cellulose acetate on the 10D—8 Oz. model, in red, yellow and ivory — the shakers from a six cavity and the threaded, transparent bottoms from a twelve cavity mold.

Seeking information about machines and molds? The builders of the largest selling line of injection molding machines in the World, invite you to submit your problems.

Model 10D—8 Oz. Plastic Injection Molding Machine. Available in 22, 16, 12, 8 and 6 Oz. Sizes.

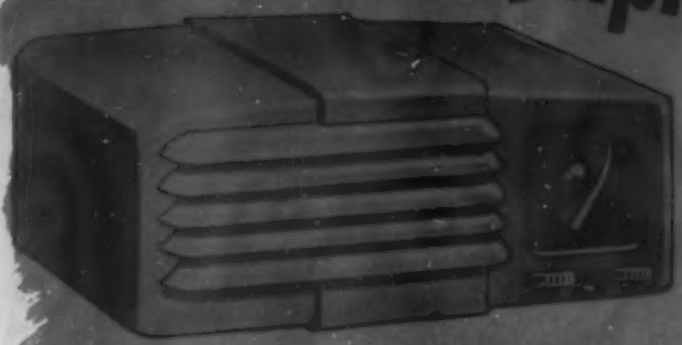


INJECTION
REED-PRENTICE CORP.
WORCESTER MACHINES MASS., U.S.A.

NEW YORK OFFICE:
75 West St., New York 6, N. Y.

CLEVELAND OFFICE:
1213 W. 3rd St., Cleveland 13, Ohio

Planning an improved product?



Take advantage of Celanese* custom-built Plastics

Do you know ... that Celanese produces a flame-resistant thermoplastic (LUMARITH XF) with the high speed molding qualities of standard cellulose acetate? ... that dial faces, covers, transparent shields and bezels can be molded to optical clarity from LUMARITH XX? ... that LUMARITH EC offers sub-zero toughness, warpage resistance, lightness and excellent moldability, all in one composition?

THESE are but a few of the new developments in Celanese cellulosic thermoplastics that soon will be available for civilian use. The war service of Celanese plastics include some of the toughest jobs thermoplastics have ever tackled: *aircraft control wheels molded over metal, corrosion resistant film insulation, interchangeable flashlight parts for arctic use, waterproof packaging of precision electrical parts, flameproof cable grommets for naval use, close-tolerance gas mask parts, instrument housings* ...

These wartime applications tell a story of thermoplastic versatility that has important implications for the designer and manufacturer. Certainly, your plans for an improved postwar product will call for the best plastic available. We suggest that you take advantage of the war experience data collected by our technical staff. It will show you what you can expect plastics to do for you, and most likely indicate how production costs can be lowered. Celanese Plastics Corporation, a *division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.

LUMARITH* PLASTICS

MOLDING MATERIALS ... FILMS

FOILS ... SHEETS ... RODS ... TUBES

*Reg. U. S. Pat. Off.

★

When the Atomic Bomb hit Taylor's...

THE Atomic Bomb landed on American industry long before it devastated Hiroshima and Nagasaki. Maybe it hit you harder than it hit us. All we know is that here at Taylor Instrument, it had an impact not only on our own organization, but on our suppliers and our customers. Here is what happened:

On a spring day in 1943, the War Department called us in to ask us if we would assume the responsibilities of prime contractor on process control instrumentation for the Kellex Corporation for a secret project called the "Manhattan District." As everybody knows now, this was the Oak Ridge Atomic Bomb Project.

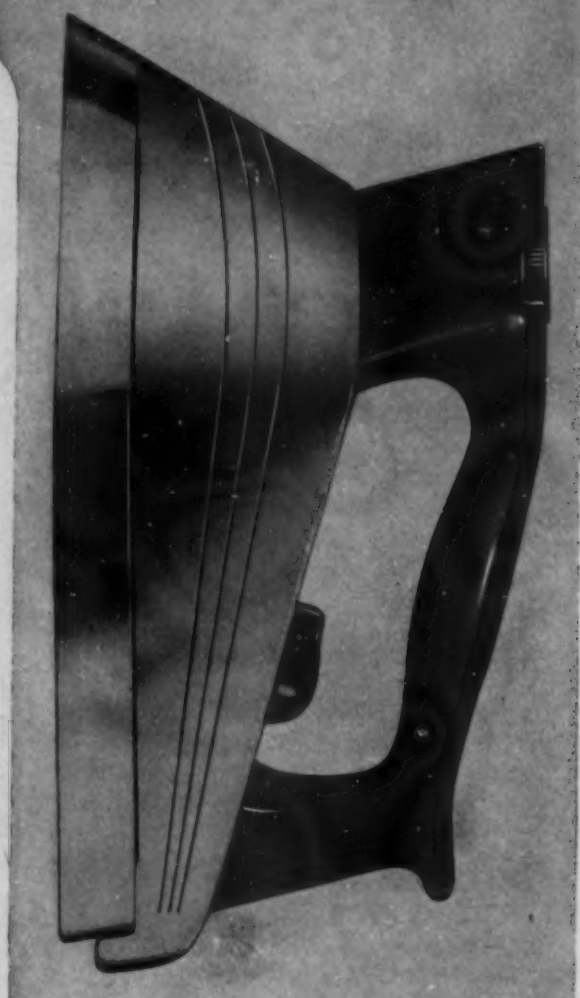
We were already supplying instruments to eleven major branches of the armed forces. Commitments to the super-critical synthetic rubber, 100-octane gasoline and chemical industries programs imposed heavy responsibilites. On top of this, war industries' needs were increasing. Materials were scarce and manpower scarcer. But we were told this was an opportunity to help shorten the war. So of course there could be but one answer.

Our responsibilities included the development, design and production — in unprecedented quantities — of a score of new types of instruments, involving new principles, and closer operating tolerances than had ever before been required of process control instruments. In addition, we were asked to loan a number of our top engineers and technicians to the project.

Our production schedules had to be overhauled. Directives over-rode high-rated war orders. Civilian orders stood at the far end of the line. But the problems were solved, because thousands of people in our plants and in those of our subcontractors devoted their whole time to the project to the extent of seven days a week, month after month.

Naturally, we're proud of the way our organization came through. But we're proud too of our many, many customers who showed patience and understanding in the face of temporary delays in delivery for which we could only offer phoney-sounding excuses. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Taylor Instruments mean "Accuracy First."*

WHY TRANSFER MOLDING PRODUCES BETTER IRONS



Modern iron handle designs call for complex side cores and undercut sections and are therefore produced at minimum costs and with maximum production rates by Transfer molding.

Because the mold is closed when the already plastic compound enters, the fin is reduced to a minimum and the parting line becomes a line without dimension. In fact, alert designers peak the parting line, making a design feature of this molding effect and thus eliminating buffing and polishing.

Actually, several of the advantages of Transfer molding are called into play by production of iron handles: lower costs, faster and longer production runs, more beauty, easier complexity, uniform strength.

Your nearby licensed Transfer molder can help you take advantage of this process, or you can learn more by writing for the literature mentioned below.

SHAW

SHAW INSULATOR COMPANY

160 COIT STREET QUALITY MARK ON MOLDED PLASTICS IRVINGTON 11, N. J.

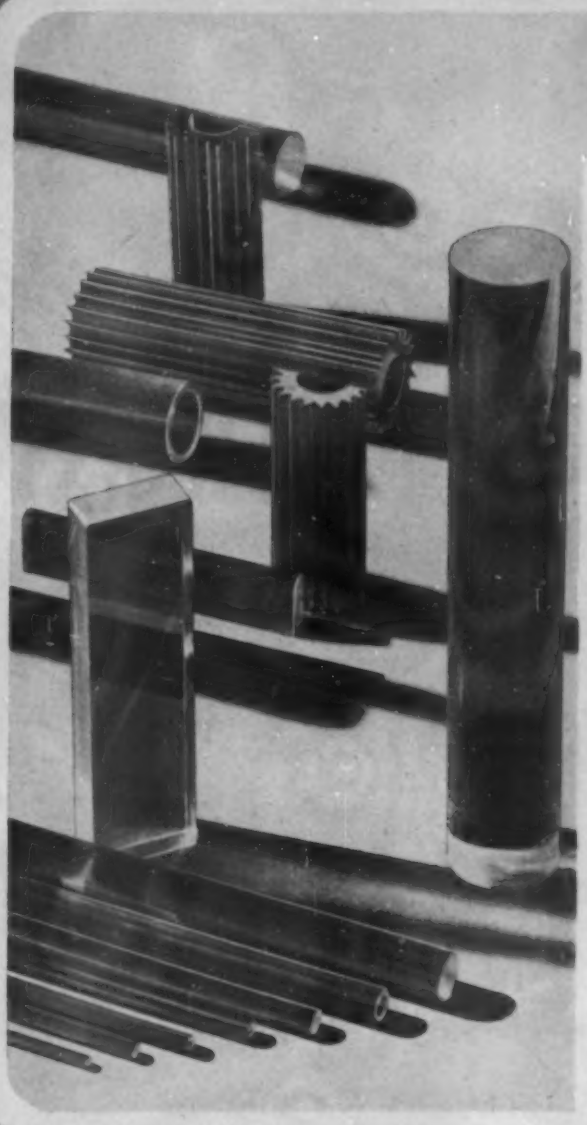
LITERATURE IS AVAILABLE AS FOLLOWS:

A list of nearby licensees who can offer you the advantages of the patented Transfer molding process.

Two bulletins on "Why Transfer Molding is Economical". Bulletins on "Why Transfer Molding Gives Fine Inserts", "Why Transfer Molding Improves Appearance", "Why Transfer Molding Permits Better Holes", "Why Transfer Molding Permits Variable Walls", "Why Transfer Molding Gives Uniform Strength", and "Why Transfer Molding Gives Longer Runs".

Unbiased counsel in plastics applications is available from Shaw and Plax Corporation, Hartford 5, Conn. Between them, these companies use nearly all plastic processes. For names of nearby licensed Transfer molders and for literature listed above . . . write Shaw.

PLAX METHACRYLATE ROD, TUBING AND FIBER



Methacrylate is supplied by Plax in various sizes and shapes of rods and tubing, and in fiber — in all colors, from clear to pearlescent. Characteristics are as follows:

MECHANICAL

Elongation, %	1-5
Tensile Strength, p.s.i.	4,000-7,000
Modulus of Elasticity in Tension, p.s.i.x10^5	3-5
Compressive Strength, p.s.i.	10,000-12,000
Flexural Strength, p.s.i.	10,000-17,000
Rockwell Hardness	M40-M70
Impact Strength, ft. lbs. per in. of notch; ½" x ½" notched bar Izod test	0.2-0.4
Water absorption, 24 hrs., %	0.4-0.5

ELECTRICAL

Volume Resistivity, ohm. cms. (50% rel. hum. at 25°C)		10^{13}
Dielectric Strength, short-time volts per mil, ⅛ in. thick		500
Dielectric Strength, step-by-step volts per mil, ⅛ in. thick		400
Frequency	**Dielectric Constant**	**Power Factor**
60	3.0-3.7	0.05-0.07
10^3	3.0-3.5	0.06-0.07
10^6	2.8-3.3	0.02-0.03

THERMAL

Distortion Temperature, °F	125-165
Transition Temperature, °F	145-185
Softening Point, °F	150-230
Specific Heat, cal. per °C per gram	0.35
Burning rate	Slow
Thermal Expansion, 10^{-5} per °C	7-9
Thermal Conductivity, 10^{-4} cal. per sec. per sq. cm/1°C per cm.	5-7
Resistance to Heat (Continuous) °F	120-160

CHEMICAL EFFECTS

Weak Acids	Practically nil
Strong Acids	Affected only by oxidizing acids
Weak Alkalis	Practically nil
Strong Alkalis	Practically nil
Alcohols	Attacked above 40%
Esters	Dissolves
Ketones	Dissolves
Aromatic Hydrocarbons	Dissolves

Liquid sight gauges, transparent models, high frequency insulation, pen and pencil parts, filtration equipment parts, decorative architectural forms, jewelry, etc. may all be advantageously produced from Plax methacrylate rods, tubing and fiber. Methacrylate has unique optical properties . . . For data on stock sizes, write Plax.

The following illustrated literature is available:

Several bulletins on Plax polystyrene products and how to machine them.

Data on Plax cellulose acetate and cellulose acetate butyrate products.

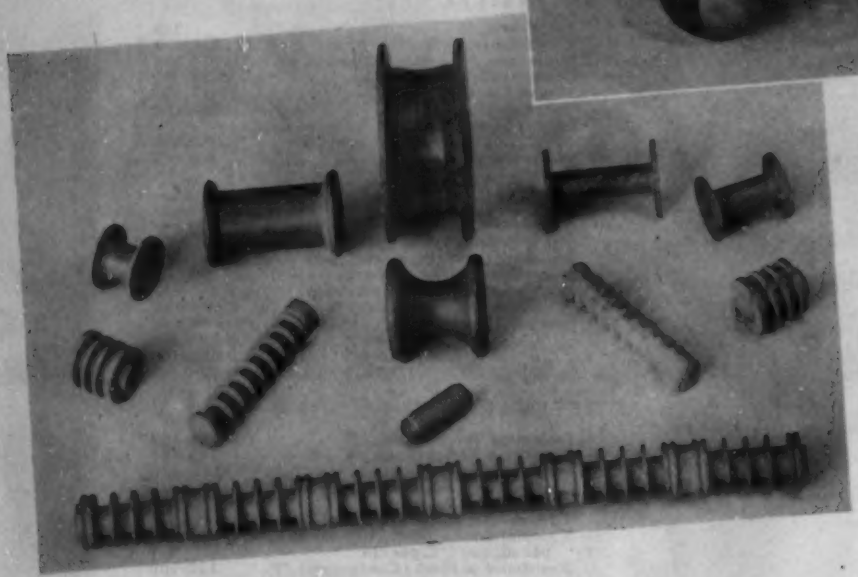
An article on Plax's blown products.

Ethyl Cellulose, Polyethylene and Styramic are among the other materials offered by Plax in various forms. In cooperation with Shaw Insulator Company, Irvington 11, N. J., Plax can give you help covering nearly all plastic materials and methods. For such help, or for any of the literature listed above . . . write Plax.

PLAX
FOR PLASTICS
NOT SUBSTITUTES · · · IMPROVEMENTS

133 WALNUT STREET ★ HARTFORD 5, CONNECTICUT

PRECISION FORMING



AN exclusive, improved process designed and engineered by TECKNA makes possible close tolerance forming in production quantities.

Any intricate cylindrical shapes formed from thermoplastic and thermosetting materials are within the scope of this newly developed plastic forming machinery. Results offered by TECKNA have never before been accomplished.

Convincing performance records and samples are available to prove the close tolerance and precise forming available thru TECKNA.

TECKNA operates its own tool room, makes its own molds and dies. Call on TECKNA for cylindrical shapes, balls, rods, pulleys, industrial and product parts.

Send for Bulletin M P outlining the completeness of TECKNA service.

TECKNA Company

FABRACATORS OF PLASTICS

223-01 Northern Boulevard, Bayside, L. I., N. Y. Phone Bayside 9-5302

Branch Factory—West Warren, Mass.

TECKNA PLASTICS

CASE HISTORIES ON

Cardolite

TRADE MARK

CASHEW RESINS

INDUSTRY — Cable
PROBLEM — Non-metallic Jacket for underground use

A cable manufacturer desired to make a non-metallic cable jacket out of GR-S suitable for underground conditions. It was found that the addition of a Cardolite Polymer to GR-S has greatly assisted in prolonging the life of the non-metallic jacket . . . inasmuch as Cardolite Polymers have excellent resistance to ground acids, alkalis and oil.

INDUSTRY — Brakelining
PROBLEM—Increasing Friction on Molded Brakelining

Manufacturer of brakelinings obtained the desired increase in frictional and other physical properties simply by substituting a small percentage of Cardolite 899 powdered resin for straight phenolic resins formerly used.

In addition to these problems that have been so efficiently and economically solved by Cardolite Resins, there are many others on record in the Irvington files. They all illustrate the versatility of the Cardolite Group — a group of resins that stem from the high molecular weight, unsaturated, phenolic-type material extracted from the shells of CASHEW Nuts.

The answer to your problem may easily be on record. Why not investigate today? Or, ask us for generous samples which will gladly be supplied. Write Department 16.

STANDARD OF THE WORLD
IRVINGTON INSULATION
TRADE MARK

IRVINGTON
VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey

Low-cost Molding Compound

"Raycolite" has opened the eyes of numerous molders to entirely new price ranges for items of the phenol formaldehyde type.

Outline the type of work you are doing, and we will indicate where "Raycolite" might apply. In addition, we furnish engineering suggestions, and provide sufficient working samples.

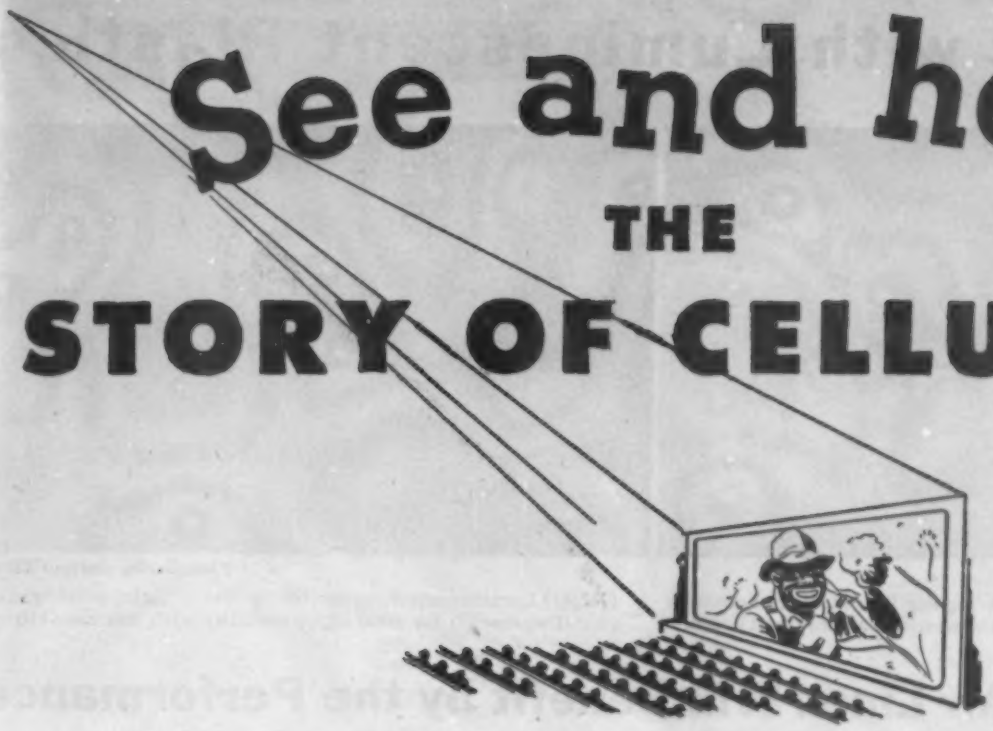
RAYCO COTTON FILLERS

"Research-Fitted" to YOUR needs

RAYCO
Fillers
RAYON PROCESSING CO. OF R.I. INC.
Developers and Producers of Cotton Fillers for Plastics

60 Tremont St., Central Falls, R. I.

See and hear THE STORY OF CELLULOSE



Free 16-mm. color-sound movie presents the possibilities of plastics right in your office

"CAREERS FOR CELLULOSE" is a fascinating picture that shows and tells the important things you should know about cellulose and its part in the manufacture of the newer plastics—and we'll gladly loan it to you free! . . . BEGINNING in the cotton fields of the South, it takes you next to the plants where cotton linters are transformed into cellulose derivatives. Here you will see the processing that marks the birth of plastics, lacquers, film, rayon, and other cellulose-based materials. A major part of the film is then devoted to the properties of cellulose plastics and how they are fabricated and formed. Numerous scenes show plastics being molded and extruded, with close-ups of various examples . . . A VALUABLE AID to researchers, designers, engineers, and production men alike, this 16-mm. color-sound film has already been seen and acclaimed by more than 20,000 representative members of the chemical industries. It will be shown in 20 Latin-American countries, after translation into Spanish and Portuguese, under the auspices of the U. S. Coordinator of Inter-American Affairs . . . "CAREERS FOR CELLULOSE" may be scheduled by returning the coupon. Bookings arranged as orders are received.

HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

CELLULOSE PRODUCTS DEPARTMENT
HERCULES POWDER COMPANY
916 MARKET STREET, WILMINGTON 99, DEL.

We would like to see "Careers for Cellulose" on any one of the following dates (give choice of three dates).....

.....

Name.....Title.....

Company.....

Street.....

City.....State.....CP-61

Designing with Luminescent Plastics

Photographs, courtesy TWA

(*Left*) An airplane cockpit with regular incandescent lighting system, showing poor light distribution on instrument panel board.

(*Right*) Luminescent dials, excited by "black" light, provide suitable illumination for good night visibility with less eye fatigue.

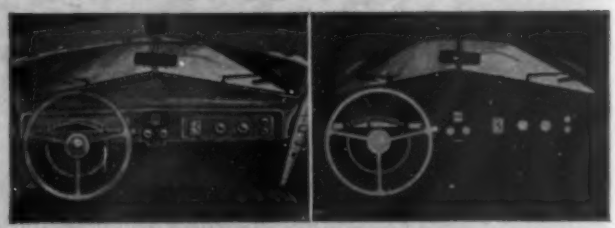
Commercial Air Lines Will Benefit by the Performance of Cockpit Illumination Used on Combat Planes

COCKPIT dials and controls on combat planes are illuminated with **HORSE HEAD* LUMINESCENT PIGMENTS** under the excitation of "black" light to provide good night visibility with no impairment of dark adapted eye, no windshield images to obstruct vision, and less eye fatigue. The advantages of this luminescent pigment—"black" light system now are available to all commercial air lines with night flights on their operations schedules.

Whether it be airplane cockpit dials, plane exit signs, or some other applications where **HORSE HEAD* LUMINESCENT PIGMENTS** can be used to improve efficiency or safety, or add new sales appeal, our technical staff will be glad to cooperate with you.

Producers of luminescent plastic sheets, granules and powders (for the manufacture of dials, controls and other luminescent articles or parts) are ready to consider inquiries. Their names on request.

*Reg. U. S. Pat. Off.



Luminescent instruments and controls provide more comfortable, less tiring night driving.

Phosphorescent plastics add sales appeal, make finding things easier in the dark.

OTHER SUGGESTED APPLICATIONS for HORSE HEAD LUMINESCENT PIGMENTS

FLUORESCENT

- Automotive and aviation dials and accessories
- Decorative effects
- Displays and advertising
- Light diffusers
- Radio dials and decoration
- Theatrical effects
- Airplane emergency exit signs
- Apparel accessories
- Architectural trim
- Automotive accessories
- Cord pulls (lights and window shades)
- Decorative effects
- Displays and fixtures

PHOSPHORESCENT

- Door knobs and kick plates
- Electric switch plates, fixtures, equipment
- Escutcheons and medallions
- Flashlights
- Fish lures
- Games
- Household items
- Jewelry
- "Juke" boxes
- Light diffusers
- Marking tapes
- Product packages and labels
- Slipper tips
- Tools

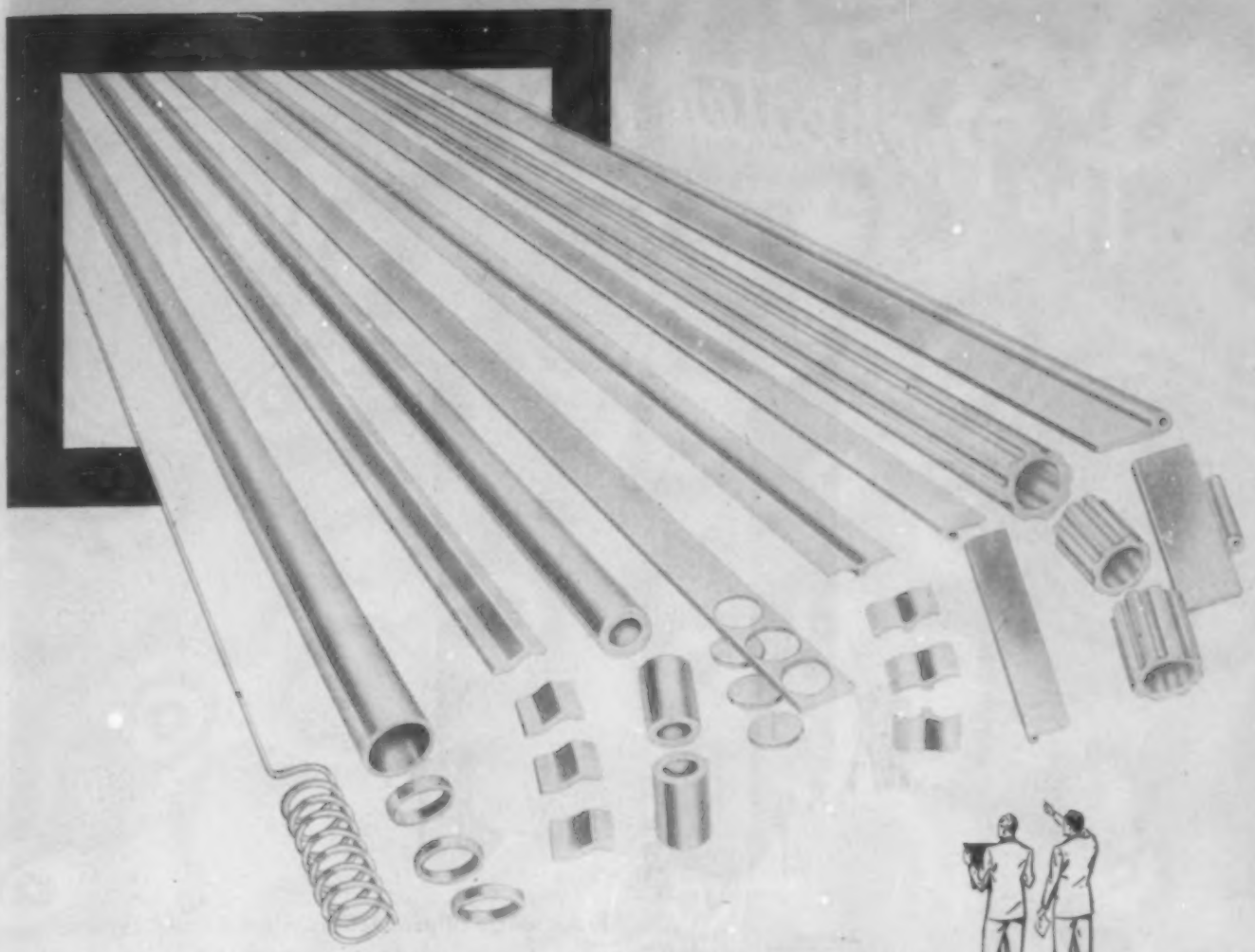
HORSE HEAD PRODUCTS
New Jersey Zinc

THE NEW JERSEY ZINC COMPANY

160 FRONT STREET • NEW YORK 7, N. Y.

***Products Distributed by* THE NEW JERSEY ZINC SALES COMPANY**

NEW YORK • CHICAGO • CLEVELAND • SAN FRANCISCO



Let your new ideas take shape by EXTRUSION!

NOW, while you're planning new products, is the time to think of them in terms of plastics extrusion. Look at the many extruded shapes shown above. Some of them are stamped, bent, or cut into sections to add another infinity of possibilities for parts production. Now, think of your own plastic parts that can be formed this same way.

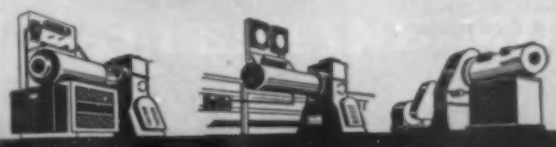
Big advantages of letting your new product ideas take shape by extrusion are these:

YOU SIMPLIFY MANUFACTURING! Plastics extrusion is a continuous process. Limitless variety of shapes are produced quickly, at low cost.

YOU IMPROVE DESIGN! The engineering of your product for production is made easier, more practicable, through the use of plastics extrusions.

YOU INCREASE SALES APPEAL! As part of your product or as a container for it, plastics extrusions provide smartness, transparency, or color, new richness of appearance.

Think of your product in terms of plastics extrusions. Then, for full information on America's most modern and complete line of extrusion equipment, write National Rubber Machinery Company, Akron 11, Ohio.

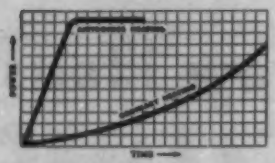


NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

The Preheater YOU Designed

Greater Preheater Utility—Dual load selection—two independent sets of time and power controls permit running two entirely different loads, alternately, or in any sequence.



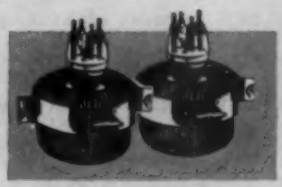
Full-Cycle Peak Heating—Automatic Power Regulation holds power output constant at the pre-set levels during the heating intervals. Automatic Excitation Regulation maintains maximum preheater efficiency.

From scores of production-minded molders have come the ideas which are embodied in the design of Airtronics preheaters. Every Airtronics feature fulfills molders' specific requirements. As a result, Airtronics brings to molders the *practical* means of obtaining *all* the production advantages of electronic preheating. This is the main reason for Airtronics' industry-wide acceptance.

Inquire at any AIRTRONICS office for full details about the complete series of AIRTRONICS Preheaters. Models are available with power outputs from 1.5 to 10 kilowatts.

"Disappearing" Set-up Controls—Dual power and time controls are mounted on a pivoting panel recessed in the cabinet front. Tilted out, control panel is fully accessible for set-up adjustments. Tilted in and locked, controls are completely out of the way—preventing unauthorized changes

"Push-button" Operating Controls—After set-up adjustment, the preheater is operated by 3 push-button switches—dual "START" switches and a common "STOP" switch—conveniently mounted on the cabinet top.



Trouble-free Performance—Long-life external anode oscillator tubes, operated far below manufacturer's ratings, insure maximum trouble-free service. All components are rated for continuous preheater operation at full output.

Airtronics MANUFACTURING CO.

CHICAGO 407 S. Dearborn Zone 5
NEW YORK 31-28 Queens Blvd. Long Island City, Zone 1
LOS ANGELES 5245 W. San Fernando Rd. Zone 26

Quiet

Design engineers looking for peak efficiency and long life in fractional H.P. motors, will pick a QUIET motor—A BALLENTINE MOTOR. Because only skilled craftsmanship, strict adherence to close tolerances, *precision dynamic balance* plus modern manufacturing methods and equipment can produce a truly QUIET motor. In BALLENTINE MOTORS, the engineer finds all these factors—*at their best*—combined with suitable mechanical and electrical design. *Quiet* BALLENTINE MOTORS are available in ratings from 1/1000 to 1/6 H.P.—adapted to your specific application. Write for descriptive bulletin.

BALLENTINE MOTORS

Manufactured by

RUSSELL ELECTRIC COMPANY

352 W. HURON STREET, CHICAGO 10, ILLINOIS

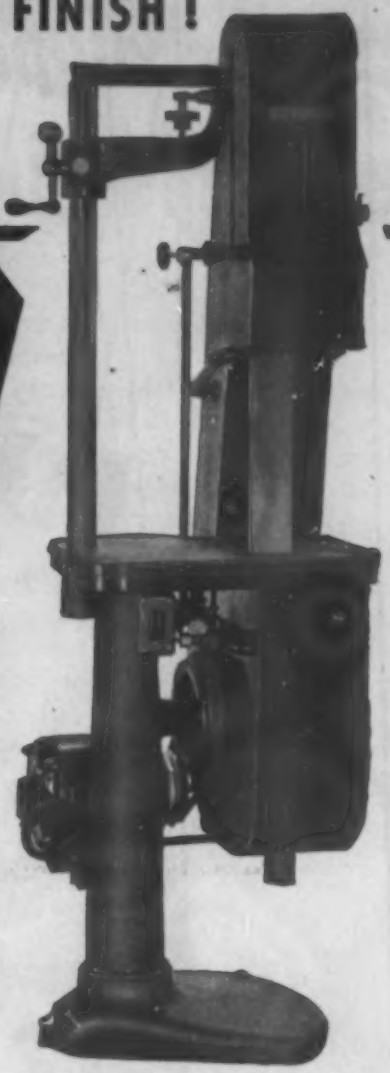

Masterpieces
for the millions...
Webster defines a masterpiece as "anything done or made with extraordinary skill." It might be a famous painting by Rosburn and accessible to only a fortunate few. Or it could be any plastic toy dishes molded by Columbia for the enjoyment of millions of America's youngsters. For these, too, reflect "extraordinary skills"... skills that have won Columbia recognition as a master of plastic craftsmanship.
COLUMBIA Plastics
COLUMBIA PROTEKTOSITE CO. INC. • CARLSTADT, N. J.
New York Offices • Empire State Building • Room 7013

INCREASE PRODUCTION! IMPROVE FINISH!

Abolish ~~DISCOLORATION~~ ~~DISTORTION~~ ~~FLOW~~

PORTER-CABLE

WET OR DRY ABRASIVE BELT SURFACER



MODEL B-6W — especially designed for curved or irregular work. Most jobs can be handled freehand, or with simple fixtures. A single pass in a fraction of the usual time — cuts cost and improves the finish.

Does them all on PLASTICS . . .

For thermoplastics and some thermo-setting plastics, experience has shown that the PORTER-CABLE Surfacing methods are best. In Wet-Belt Surfacing, the coolant is sprayed on the belt before and after cutting, keeping it free and clean. Because there is no heat, the grindings do not "weld" and load the belt. Wet or Dry—the PORTER-CABLE Surfacing technique does a better, closer, finer job because a flexible belt follows the contour and gets into places other power tools won't reach. For repeat operations a padded platen fits the belt to the contour of the job. Round pieces, held on an arbor, rotate with the belt for perfect roundness.

HERE ARE *ALL* THE FACTS WRITE TODAY for your FREE

copy of the handbook, "A New Precision Machining Method." It describes a process as new — as vital — as the Plastics industry itself!

MODEL G-8 — for close-limit work on a high-production basis. Semi-skilled, even "green" operators, can finish true flats to close limits of flatness and parallelism. Single pieces can be finished freehand, or mounted in gang jigs for simultaneous finishing of several parts in one pass.

PORTER-CABLE MACHINE CO.
1606-11 N. Salina St., Syracuse, N. Y.

Please send me a copy of "A New Precision Machining Method."

Name..... Position.....

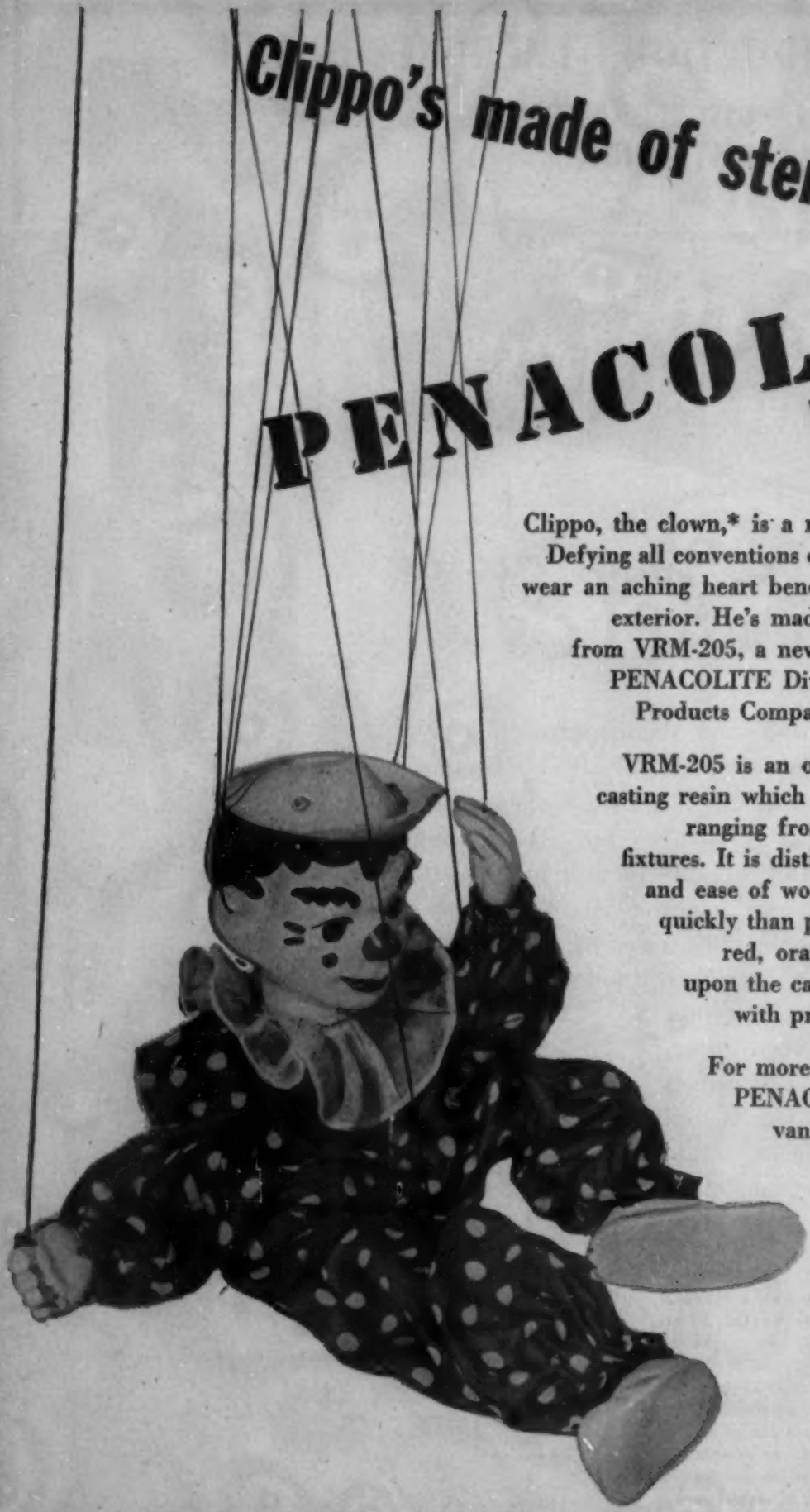
Company.....

Street.....

City..... State.....

Clippo's made of sterner stuff...

PENACOLITE VRM-205



Clippo, the clown,* is a mighty unusual little fellow. Defying all conventions of the show world, he doesn't wear an aching heart beneath his painted and rouged exterior. He's made of sterner stuff. He's cast from VRM-205, a new casting resin developed by PENACOLITE Division of Pennsylvania Coal Products Company.

VRM-205 is an opaque, dimensionally stable casting resin which may be used in many fields ranging from cast novelties to jigs and fixtures. It is distinguished by new economies and ease of workability, and it cures more quickly than phenolics. Natural colors are red, orange, and yellow, depending upon the catalyst used. It is compatible with practically all fillers.

For more detailed information write PENACOLITE Division, Pennsylvania Coal Products Company. Petrolia, Pennsylvania

*Clippo, the clown, the first plastic puppet, was designed by Virginia Austin, and is manufactured by Curtis Crafts, New York City.

PENNSYLVANIA COAL PRODUCTS COMPANY

PETROLIA, PENNSYLVANIA

Better functional insulating parts for radio and electronic equipment

THE excellent electrical properties of Panelyte*, including high Dielectric Strength, low Power Factor, and low Dielectric Constant, have long been recognized in the electrical industry. Combined with these fine dielectric characteristics, the high structural strength, dimensional stability, low moisture absorption, and easy machinability of Panelyte electrical grades have made them the logical choice for such insulating parts as coil forms, instrument panels, terminal strips, socket bases, etc., used in radio, electronic and telephone equipment.

For such applications, Panelyte is available in the form of sheets, rods, and tubes, and also, fabricated parts and molded shapes.

Of the many Panelyte grades manufactured, these are specifically recommended for electrical applications: #110 (glass mat base), #140 (glass fabric), #776 (paper base), #520 (paper base), #774 (paper base), #550 (paper base), #770 (paper base).

Factual Data Sheets and samples of all these grades are avialable at your request. For specific applications, a Panelyte Sales Engineer will be glad to visit your offices to recommend suitable grades and outline our facilities for supplying your requirements.

• High Dielectric Strength • Low Power Factor • Low Dielectric Constant • High Insulation Resistance • Low Loss Factor
• Low Water Absorption • Easy Machinability • Light Weight • Corrosion Resistance • Low Friction Coefficient
• Low Thermal Conductivity • Good Dimensional Stability • Excellent Heat Resistance • Unusual Structural Strength

JAN-P-13, 17P5, and corresponding Panelyte Grades

17P5 Type	JAN-P-13 Type	PANELYTE
PBM	LTS-M-1	750
PBG	LTS-E-2	550
PBE	LTS-E-4	520
—	—	770-772
PBG-P	LTS-E-3	774
PBE-P	LTS-E-5	776
FBM	LTS-M-4	900
FBG	LTS-EM-1	910
FBI	LTS-M-3	940
FBE	LTS-EM-2	950
PBH	LTS-H-1	580
FBH	LTS-MH-1	980
GBE	LTS-E-6	110
GMG	—	140

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

★ MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS IN PAPER, FABRIC, FIBRE GLASS, WOOD VENEER AND ASBESTOS BASE LAMINATES

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Nashville, New Orleans, Phoenix, Portland, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Trenton; Buenos Aires, Johannesburg, Mexico City, Montreal, Sao Paulo, Toronto, Vancouver.

CASE HISTORIES PROVING THE POWER OF THE PRESS

LAKE ERIE IS READY FOR THE PLASTICS AGE

LAKE ERIE self-contained, semi-automatic hydraulic presses offer many new developments for all types of plastic molding.

Illustrated are two of these latest presses of sixty tons capacity; 18″ x 16″ platens; 12″ stroke. These units have complete time cycle and full automatic push-button control, including adjustable plasticizing and breathing stroke.

Lake Erie is ready for the "plastics age". We can adapt standard presses to your compression molding needs or build special presses to your specific requirements. Write for information.

LAKE ERIE
ENGINEERING CORP.
BUFFALO, N.Y. U.S.A.

LAKE ERIE ENGINEERING CORPORATION
868 Kenmore Station, Buffalo 17, N. Y., *Offices in Principal Cities*

Treasured Possessions

protected with

PLEXIGLAS

IF your product requires a package appropriate to the beauty and value of the article itself, it will pay you to investigate PLEXIGLAS for containers. The combined protection and visibility afforded by this war-famed crystal-clear plastic may provide the key to more effective product merchandising.

Military decorations... collectors' treasures ...jewelry: all can be safeguarded from dust or marring, yet displayed in an appropriate setting—with transparent PLEXIGLAS.

To take a single instance: in a new case officially adopted by the War Department, the Purple Heart rests on a velvet-lined base of purple PLEXIGLAS. A hinged transparent PLEXIGLAS cover, dustproof when closed, gives complete visibility.

Our technical staff will be glad to discuss with you possible applications of PLEXIGLAS—as a container material, and as a means of increasing sales appeal in your products themselves. Just write or call our nearest office: Philadelphia, Detroit, Los Angeles, Chicago, Cleveland, New York. Canadian Distributor: Hobbs Glass Ltd., Montreal.

Molders who have produced the case shown above include General Products, Providence, R. I., Scholl Manufacturing Company (Chicago Plastics Products), Chicago, Ill. and Standard Plastics Company, Attleboro, Mass.

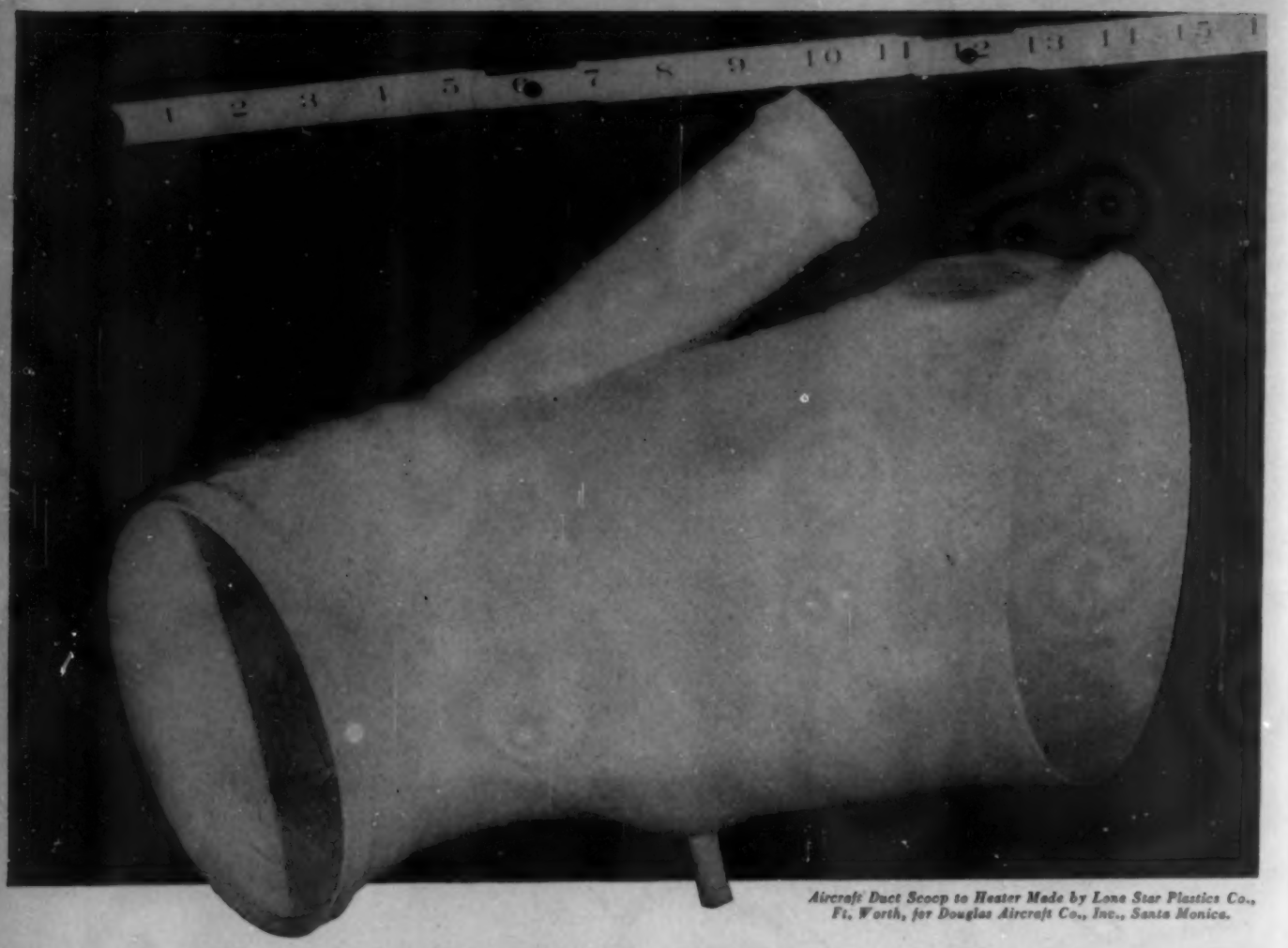
ONLY ROHM & HAAS MAKES PLEXIGLAS CRYSTAL-CLEAR ACRYLIC SHEETS AND MOLDING POWDERS

PLEXIGLAS *is a trade-mark, Reg. U. S. Pat. Off.*

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics · Synthetic Insecticides · Fungicides · Enzymes · Chemicals for the Leather, Textile and other Industries



Aircraft Duct Scoop to Heater Made by Lone Star Plastics Co., Ft. Worth, for Douglas Aircraft Co., Inc., Santa Monica.

IT HAS 300°F. TEMPERATURE RESISTANCE

. . . another Fiberglas*-reinforced plastics plus value

As an example of the high temperature resistance of Fiberglas-reinforced plastics—ducts for aircraft are being made to withstand 300° F. for 17 hours without serious loss of strength. No other plastics reinforcing material can retain its strength under such temperatures.

The use of Fiberglas Cloth (woven from yarns of fine, strong filaments of glass) as reinforcement for low- or contact-pressure resins, results in laminated sheets, structural and formed parts which possess a *combination of characteristics not to be found in any other material.*

Heat resistance is only one of these properties. Fiberglas-reinforced plastics also have great tensile, compressive, flexural and impact strength per unit of weight; they resist moisture; they are dimensionally stable.

And there's the economy of fabrication to be considered, too. Expensive dies and heavy presses are not required. Large, complicated parts can be laid up and formed in one operation, resulting in a monolith or a monocoque of great strength, yet surprisingly light weight.

Take another look at your product. Regardless of its size, if you are designing for lighter weight; if you want a material that will not dent; if you are confronted with the problem of frequent design changes; if production volume does not justify die costs—then plastics reinforced with Fiberglas may be your answer. It's worth investigating, today. *Owens-Corning Fiberglas Corporation, 1876 Nicholas Building, Toledo 1, Ohio.*

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

Owens-Corning Fiberglas Corporation does not manufacture resins or fabricate laminates but will be glad to supply experimental samples of Fiberglas Cloth and data on techniques in its use with plastics.

FIBERGLAS . . A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

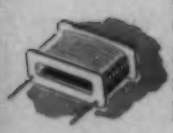
A statement about DU PONT

The turning point is here. For the past several years, we, like other manufacturers, have been producing plastics entirely for war. From now on, the plastics we produce will go to fill the different but no less urgent needs of a nation at peace.

As we turn this important corner, we feel that you, our present or possible future customers, are entitled to know the answers to these questions: "What has been the progress of Du Pont plastics during the war years? In the light of that progress, what can these plastics now reasonably expect to contribute to America's peacetime economy?"

During the war years, Du Pont brought out two wholly new plastics, in addition to improved forms of others.

POLYTHENE—One newcomer—used extensively for many applications during the war—is Du Pont *polythene*. This chemically inert thermoplastic is the lightest of all thermoplastics commercially produced. Polythene is admirably suited for insulation of wire for high-frequency current; its excellent electrical properties include low power factor, low dielectric constant, high resistivity and high dielectric strength. Its water absorption is less than 0.005%. It has served the Army as insulation for telephone wire—lessened the weight to the point where a man can readily carry a mile of wire on his back. It is being and will be used in television cables, as containers for highly corrosive chemicals, as a packaging material, and for shower curtains and umbrella coverings. Polythene, originated in England by Imperial Chemical Industries, Ltd., has been developed and improved by Du Pont.



NYLON MOLDING POWDER—Another newcomer is *nylon* for use as a plastic. Nylon molding powder FM-1, for injection-molding, offers unusual toughness and a high service temperature, which under some conditions is as high as 380° F. Also, nylon retains its impact resistance at sub-zero temperatures. Its chemical resistance is better than that of most thermoplastics; nylon resists esters, ketones and alkalis. Nylon FM-1 has replaced bronze as a valve seat, holding high air pressure in U. S. Navy torpedoes. It has also been used for electrical coilforms in telephone headsets. Other uses will be tumblers, tableware, slide fasteners, and combs. A whole new field of use for nylon FM-105 is in extrusion jacketing of insulated wire, where it contributes resistance to abrasion and to gasoline and other organic solvents. Still other new nylon formulations provide a selection of outstanding properties for specific jobs—expanding the field of nylon applications, already varied.

"LUCITE"—"Lucite" methyl methacrylate resin returns from war with its virtues of transparency, good optical qualities, lightness in weight, proved by service in many critical applications. The enclosures on nearly all our fighting planes were made of "Lucite." So great was the Army's and Navy's demand that production was increased tenfold with *five* resultant price reductions. Builders of civilian airplanes will surely profit by their war experience with "Lucite." It does not discolor with age—in fact, you can expect "Lucite" to last for the normal life of the plane. Products made from "Lucite" are moisture-resistant, and are not affected by sunlight, alkalis, oils and dilute acids. Peacetime markets have stored up a huge demand for "Lucite"—to be used for compacts, medical instruments, television lenses, airport light lenses, sparkling display fixtures, decorative home furnishings—uses old and new.

PLASTICS *present and future*

NYLON PAINTBRUSH BRISTLES—Also new are tapered *nylon bristles* for paintbrushes. When the war began, they had not been perfected; today they have years of service behind them. The Navy has used millions of them. Repeated tests show that nylon bristles which are tough and resilient, also resist attack from cold-water paints or kalsomine, and possess a combination of advantages unobtainable in any other type of bristles. They spread paint evenly and well, and they last at least three to five times longer than the best natural bristles.

HEAT-RESISTANT "LUCITE"—An added wartime development is a new formulation, HM-122, high heat-resistant "Lucite" molding powder. HM-122 provides heat-resistance 30 to 40° F higher than that of general-purpose acrylic powders. In war it has been used for military vehicle lenses, parts of sextants, airfield landing-light lenses. In peace it will serve, among other uses, in automotive, refrigerator and radio parts. It can be produced in a variety of attractive colors. Two other new formulations of "Lucite" powder provide ease of molding with various degrees of heat resistance. These "Lucite" molding powders require a minimum of finishing operations after molding.

OTHER DU PONT PLASTICS—The war years saw those old reliables, "Pyralin" cellulose nitrate plastic and "Plastacele" cellulose acetate plastic, take on a wider variety of jobs, often saving weight and conserving precious metal. "Butacite" polyvinyl butyral resin, the tough plastic used as the interlayer of safety glass, has also been used successfully between sheets of "Lucite" to protect airplane enclosures of pressurized cabins against shattering. "Butacite" sheeting remains flexible and tough under a wide range of temperatures. In flake form, "Butacite" forms an excellent impregnating and waterproofing medium for fabrics; it is also used for fabric coatings (hospital sheeting, raincoats, etc.).

From Du Pont's extensive *research*, several promising new plastics are expected to be ready during the first five post-war years. To produce these plastics and to meet expanding demand for existing ones, Du Pont is erecting a *new plant*, in addition to the present operation of one of the largest plastic plants in the country. These plastics will help perform many tasks better and more economically; they will also make many products more attractive, more salable. And so, Du Pont faces the future with confidence—confidence that in the years immediately ahead more people can apply plastics for more and different purposes.

The broad experience of the Du Pont plastics engineers is at your service, to help you determine whether a Du Pont plastic can help your product do a better job. Address: E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, New Jersey.

Share in the Victory—BUY BONDS

for **PLASTICS**. . *consult* **DU PONT**

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

YOUR ANSWERS WILL CHANGE THIS PICTURE

We've designed this mill specifically for high temperature converting and mixing of plastics.

The rolls are chamber-bored to provide uniform heating, and are fitted with special stuffing boxes. The water-cooled journal boxes supporting the rolls are lubricated by a continuous oil circulating system.

Other standard features include: adjustable guides . . . cut spur drive and connecting gears running in an oil bath . . . housings, bedplate and bull gear made of Meehanite for maximum strength.

The rest of the design . . . the part that will make this *your* mill and will assure maximum processing efficiency for you, depends on your particular requirements. When we know the job you want to do, we can build a mill to fit your needs exactly.

Where special care must be taken to prevent contamination of materials being processed, the rolls can be chrome-plated and the adjustable guides and mill pan made of non-corroding metals.

A special ratchet attachment can be provided for raising the guides to permit thorough cleaning of the rolls and the under side of the guides themselves.

You can have motor-operated roll adjustment for regulating the gauge while the batch is in process on the mill. This device allows adjustment of either end separately or both ends together. A pull-back attachment permits movement of roll in both directions.

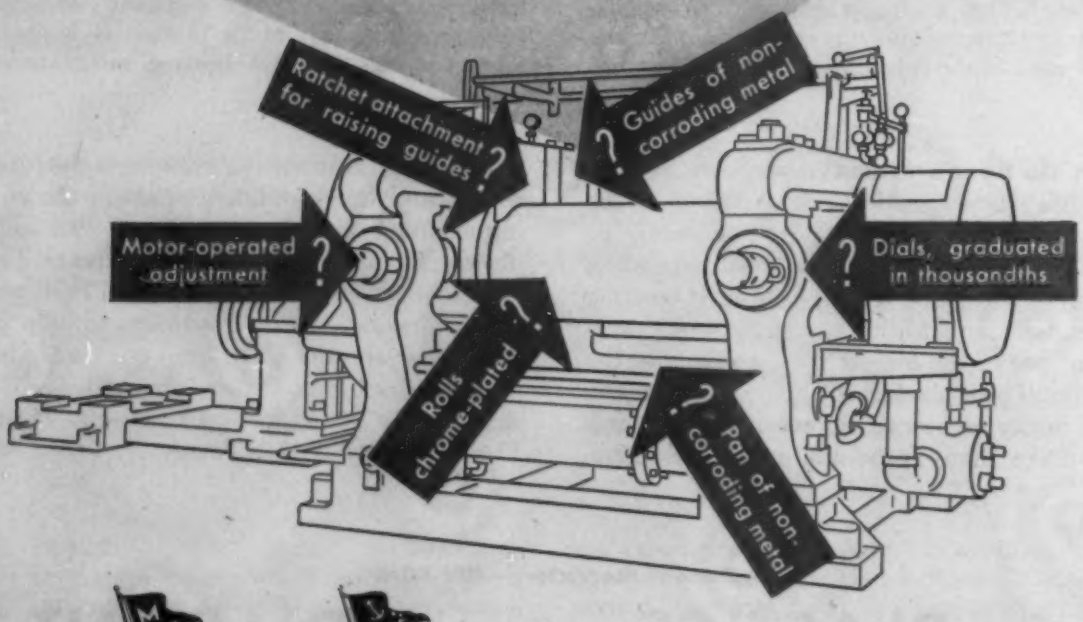
For accurate control of gauge, the front roll adjusting screws can be fitted with graduated dials to indicate roll movement in thousandths of an inch.

In short, we'll provide your mill with whatever attachments and equipment are necessary to make it "custom built" for the job you want it to do.

Farrel-Birmingham mills are available in a complete range of sizes from 8" x 16" for the laboratory up to 28"x 84" heavy duty mills for the factory. Write for complete information.

F-B PLASTICS MACHINERY
Banbury Internal Mixers • Roll Mills
Converting, Mixing and Sheeting Rolls
Calenders • Extruding Machines
Hydraulic Presses • Hydraulic Accumulators
Sheet Cutters or Planers

FB-253



Farrel-Birmingham

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN.
Plants: Ansonia, Derby and Stonington, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles, Tulsa, Houston, Charlotte

Record-breaking news!

THEY'RE HERE AT LAST—phonograph records that survive all ordinary hazards of home use. Bump them against the furniture! Drop them on the floor! Bend them and see their amazing flexibility and resilience! These new RCA Victor Red Seal De Luxe records are made of VINYLITE plastics and spell the end of the broken record era—of annoying and costly replacements of favorite recordings. Still more important, records of VINYLITE plastics have remarkable new fidelity and clarity of tone, and almost complete absence of surface sound. As never before, they bring into the home the "live" music of the concert room.

Toughness, flexibility, resistance to wear, and exceptional dimensional stability make records of VINYLITE plastics the finest ever produced. But in addition, VINYLITE plastics are highly resistant to moisture, chemicals, and oxidation. One of the most versatile of modern materials, VINYLITE plastics are breaking old performance records and establishing new standards of durability and service for wire and cable insulation, molds of duplicate printing plates, a widespread variety of molded parts, and coatings for paper, textiles, metals, and cement. They're available as films, sheeting, and rigid sheets for applications ranging from rainwear and wrappings to measuring and calculating instruments of the utmost accuracy.

Write Department 7-R for detailed information about VINYLITE plastics and their possible use for the improvement of your own products.

BAKELITE CORPORATION *Unit of Union Carbide and Carbon Corporation* UCC 30 EAST 42ND ST., NEW YORK 17, N.Y.

TUNES OUT TROUBLE

When slotted screws were used by this musical instrument maker, head breakage and driver skids damaged expensive assemblies – required disassembly, costly refinishing, and reassembly. A shift to Phillips Recessed Head Screws ended this trouble, permitted lower assembly costs.

SWING TO SAVINGS

Because the recessed head makes more efficient use of turning power, Phillips Screws can be set up tighter without danger of burring. As a result, fewer Phillips Screws are needed to make the rigid assembly required – a further saving in time and material.

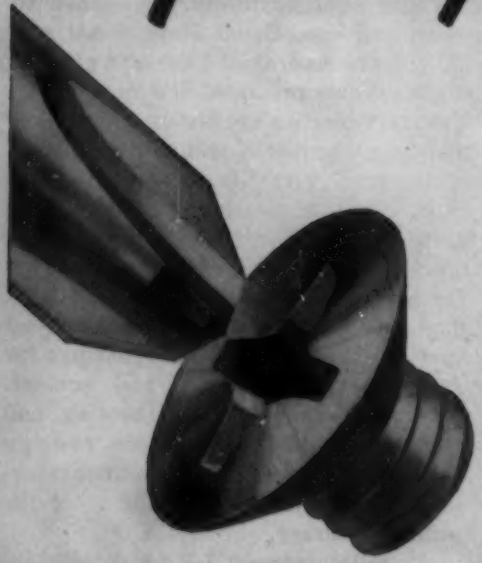
IN TIME WITH TOMORROW

Besides reducing costs and speeding up production, Phillips Screws help designers plan new, simpler methods of achieving strength, rigidity, and improved appearance. Result – a product in step with design trends – and a match for competition in tomorrow's tough markets.

SALES HIT HIGH NOTE

From the sales angle, Phillips Recessed Heads make fastenings a *feature!* No unsightly burrs to cool off prospects! The ornamental pattern of the Phillips Recess blends in harmony with modern design . . . helps start cash registers ringing a sweet sales symphony!

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

25 SOURCES

American Screw Co., Providence, R. I.
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Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
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The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
The Steel Company of Canada Ltd., Hamilton, Canada
Wolverine Bolt Co., Detroit, Mich.

now you can have

FLAME-RESISTANT THALID XR-540

for impression molding

Developed for vital war usage . . . e.g., personal body armor and laminating wing liner board for aircraft . . . this new formulation of Thalid* impression molding resin, is now ready for commercial applications. It's another Monsanto first.

Laminates of Thalid XR-540 are actually self-extinguishing . . . will not support combustion. In aircraft and electronic applications . . . and other anticipated applications . . . where the rate of burning is critical, this new Thalid property is invaluable.

In addition, Thalid XR-540 offers substantially the same physical properties as previous formulations of this unique, completely reactive thermosetting resin. The same, large, infusible, rigid panels and complex forms are possible . . . interesting color and surface opportunities are there . . . and you get the same economical fabricating advantages—rapid cure at low temperatures with low pressures.

If you've been interested in Thalid before for its amazing potentials in aircraft, boats, buses, trailers, building construction, refrigerators, toys, packaging, furniture, luggage, etc. . . . you've two more reasons to act today: *Fire-resistance* and *availability*. Write, wire or phone for complete Thalid XR-540 technical data: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts.

The broad and versatile family of Monsanto Plastics includes: Lustron* polystyrenes • Cerex* heat resistant thermoplastics • Vinyl acetals Nitron* cellulose nitrates • Fibestos* cellulose acetates • Thalid* for impression molding • Resinox* phenolics • Resimene* melamines • Forms in which they are supplied include: Sheets • Rods Tubes • Molding Compounds • Industrial Resins Coating Compounds • Vuepak* rigid, transparent packaging materials.

*Reg. U. S. Pat. Off.

Write for details on how to use our free consultative service on plastics problems
MONSANTO PLASTIC TECHNICAL COUNCIL

MONSANTO
PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

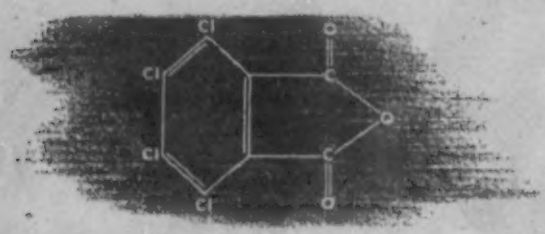
PRESENTING...

Niathal

TETRACHLORO PHTHALIC ANHYDRIDE

A NEW AND VERSATILE INDUSTRIAL CHEMICAL For Which A Manufacturing Process Has Been Developed

● NIATHAL* is fully chlorinated Phthalic Anhydride—all four hydrogen atoms being replaced by chlorine. The molecular structure of Tetrachloro Phthalic Anhydride may be represented as follows: The molecular weight of this compound is 285.9 and the chlorine content is 49.6%. It is made by a novel process for which patent protection is pending.



PROPERTIES—NIATHAL is an almost white, odorless powder. Its purity is greater than 99%, the remainder being chiefly chemically bound water. It is free-flowing and non-hygroscopic.

NIATHAL melts with very slight decomposition at 254-255°C (255°C=491°F), as against 254.9°C for the 100% pure compound. It has an appreciable vapor pressure at elevated temperatures and particularly above its melting point. It boils at approximately 362°C (684°F).

Although our own experience indicates that NIATHAL is non-irritating and non-toxic, we recommend suitable precautions when using it for making new compounds and products.

SOLUBILITY—100 parts of water dissolves with difficulty up to 0.33 parts of NIATHAL at 20°C and about 1.6 parts at 90°C, forming the corresponding dibasic acid. A pH of about 2.0 characterizes this solution.

With caustic soda or caustic potash solutions NIATHAL readily forms the neutral alkali salts, both of which are highly soluble; about 35% aqueous solutions of these salts may be obtained at 65°C. These salts, as well as the slightly soluble acid salts, form crystalline solids. NIATHAL forms nearly insoluble salts of several common metals.

NIATHAL is soluble in several organic solvents. For example, 2 to 6% solutions may be obtained at room temperature in Acetone, Benzene, and Chlorobenzene. Solubilities materially increase with elevation of temperature.

USES—Since Phthalic Anhydride has found extensive use in numerous synthetic organic chemical industries, it is predicted that the chlorinated product will also find large and varied outlets. The introduction of almost 50% chlorine into the molecule yields new and interesting properties. The chemical structure is highly stable. This fact, in combination with high melting point, suggests that compounds made from NIATHAL may be used at more elevated temperatures. High chlorine content also improves resistance to fire.

NIATHAL is suggested for use as an intermediate or compounding material in the manufacture of...

DYES • ESTERS • SYNTHETIC RUBBERS
PHARMACEUTICALS • PLASTICIZERS • INSULATING MATERIALS • FUNGICIDES • PROTECTIVE COATINGS • LUBRICANTS • SYNTHETIC RESINS.

SHIPPING CONTAINERS—NIATHAL will be shipped in fiber containers or paper-lined wooden barrels of various sizes. It is at present available only in experimental amounts. Sample on request.

*Trade Mark Registration applied for

Niagara ALKALI COMPANY

"An Essential Part Of America's Great Chemical Enterprise"

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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"Jack of all trades"
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ALL PLASTIC MATERIALS

☆ For Mass Production Products ☆

High precision and fine accuracy is our code of operation. Photo above shows high impact material used in molding anchor plates, medium impact material for intercommunication devices, mineral filled material for cable jackets and rag filled material for connector blocks. Regardless of the formula needed to fit the purpose, INTERNATIONAL can do your molding with speed, precision and promptness. Mold building facilities in our plant. Write us.

INTERNATIONAL MOLDED PLASTICS, INC.

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Speeding Laminate Production

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in Scores of Industries

A few of the fast curing Phenolic Resins and Varnishes from the World's Largest Producer of Synthetic Resins

P-398 — For exterior plywood. Requires no catalyst . . . wood failure is exceptionally high . . . cures rapidly at moderate temperatures . . . requires only 75 to 250 pounds pressure.

No. 5000 — Fast-curing resin for automobile sunvisors and general flat stock and structural laminates. Ordinarily employed with kraft paper. Cured at 1000 to 2000 pounds pressure psi.

No. 5031 — Creosol base punching stock varnish, producing, with paper, laminates of the very best dielectric strength. Cures at 70 to 80 pounds steam pressure on platens. Hot punches especially well.

No. 5013 — Low-pressure resin widely used with high strength paper using only 150 to 250 pounds pressure to produce a laminate with a tensile strength of 35,000 to 40,000 pounds.

No. 5015 — Water-dilutable to as much as 10 parts water to 1 of resin. Exceptional penetration plus good water and chemical resistance gives it wide usefulness.

No. 5022 — Exceptional curing speed—as rapid as 3 minutes with sheets .16 of an inch thick. Produces odorless laminates with excellent water resistance and mechanical properties and can be used for low or high pressure laminating.

SPECIAL NOTE

RCI is also headquarters for surface-coating resins including: Super-Beckacites for highest grade spar varnishes . . . Beckacites for architectural varnishes and enamels . . . Beckosols for all types of industrial and architectural finishes . . . Beckamines for imparting hardness to baked finishes.

RCI also supplies Beckamines for developing wet-strength in papers as well as for water- and weather-resistance in fibre-board adhesives. Plyamines for plywood are another important RCI product.

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For the molding of all plastics by any method ..W-S has the answer

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- *Transfer* • *Compression*
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- *Economy of Production*
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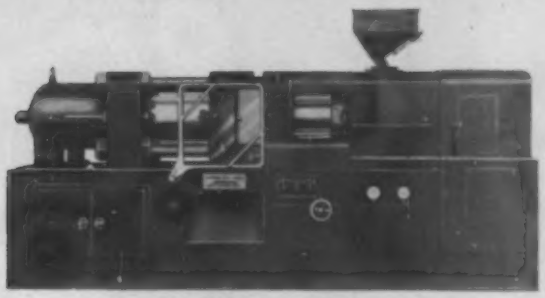
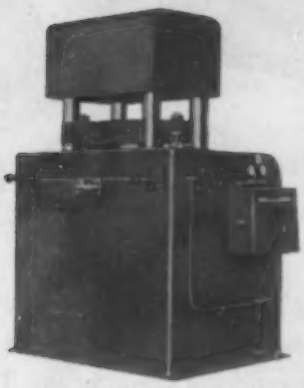
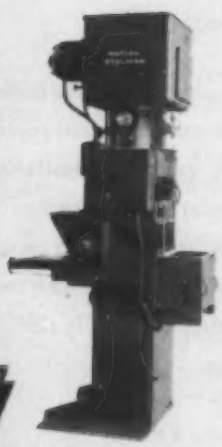


HORIZONTAL INJECTION MOLDING MACHINE



RECORD PRESS

HYDRAULIC TABLETING MACHINE



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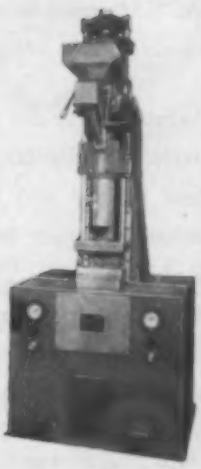

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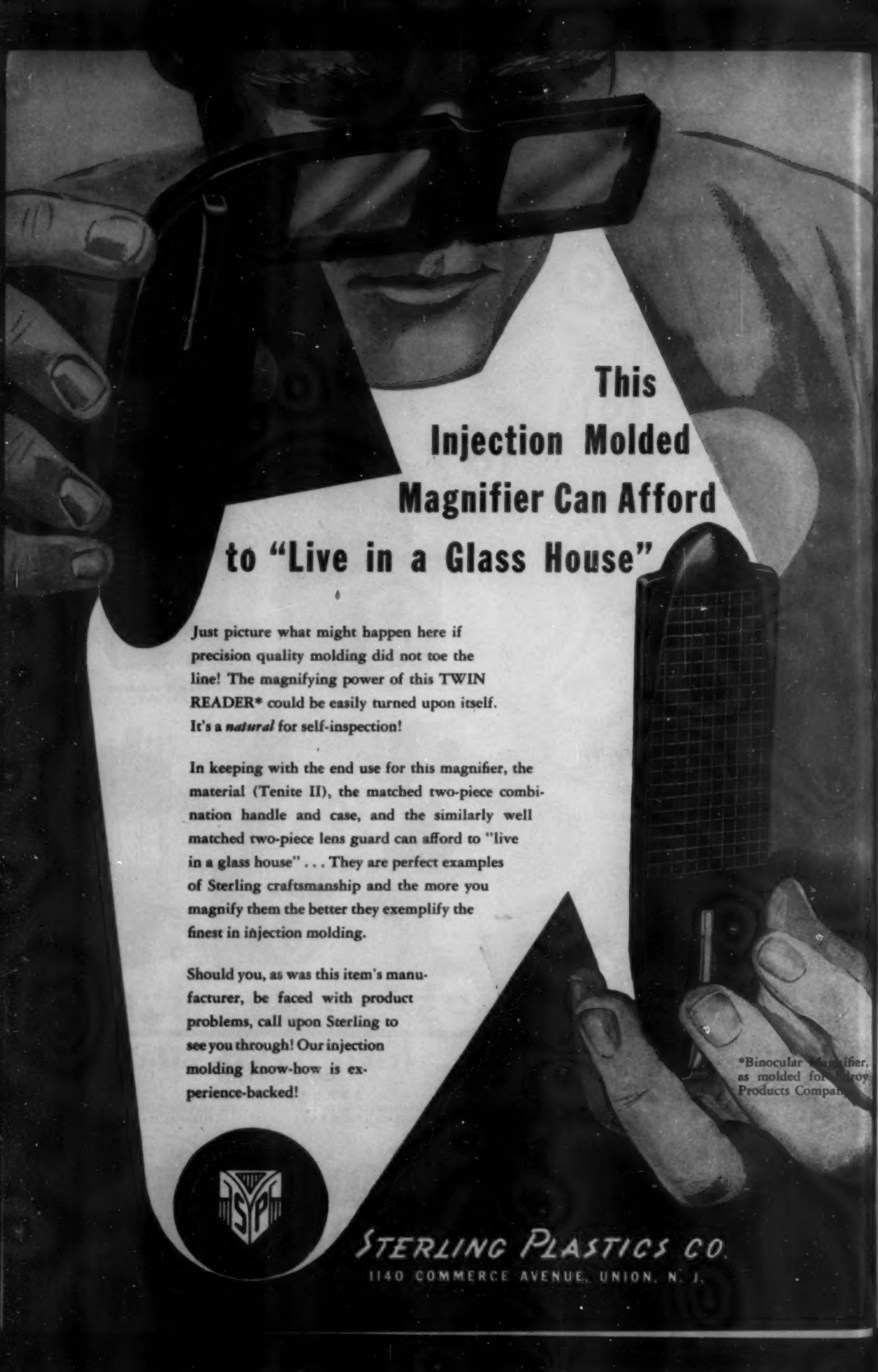

This Injection Molded Magnifier Can Afford to "Live in a Glass House"

Just picture what might happen here if precision quality molding did not toe the line! The magnifying power of this TWIN READER* could be easily turned upon itself. It's a *natural* for self-inspection!

In keeping with the end use for this magnifier, the material (Tenite II), the matched two-piece combination handle and case, and the similarly well matched two-piece lens guard can afford to "live in a glass house" . . . They are perfect examples of Sterling craftsmanship and the more you magnify them the better they exemplify the finest in injection molding.

Should you, as was this item's manufacturer, be faced with product problems, call upon Sterling to see you through! Our injection molding know-how is experience-backed!

*Binocular [illegible]ifier, as molded for [illegible]roy Products Compan[illegible]

STERLING PLASTICS CO.

1140 COMMERCE AVENUE, UNION, N. J.

Molding Plastics with Metal Inserts?

Electronic Preheating Can Help You

Users of this completely automatic RCA electronic preheater report production increases in usable molded parts of 50% to 500%! Cost reductions may pay for the equipment in a matter of months.

Wide experience of plastics molders shows electronic heat reduces rejects, simplifies molding, increases output 50%

If you are combining metal and plastics—if you are molding plastics parts with metal inserts—you'll find that electronic preheating can be of considerable help. Speedy electronic preheating provides almost amazing plasticity...allows you to mold at low pressure.

Because molding pressures are low, the danger of forcing inserts out of line is greatly reduced. Furthermore, the possibilities for mold damage are practically eliminated. Along with these important advantages, electronic preheating makes for a generally improved product and considerably increased production rate.

If you are a molder, RCA engineers will gladly advise you on the proper equipment and procedures to use in obtaining improved results with electronic preheating. You will find greatly increased production, and lowered over-all costs. Records kept by molders using electronic preheating show production increases of usable parts as high as 500%, and cost reductions of at least 50%—all costs included. Send the coupon below for details.

If you are a plastics buyer and do not do your own molding, ask the custom molder who serves you about electronic preheating. He may be able to solve a problem for you by the use of electronic preheating. A recent survey conducted for RCA among plastics molders shows that an overwhelming majority of those questioned prefer electronic preheating as the Number One method of preheating because it gives a better molded product at higher production rates.

RCA Electronic Heating Equipment specially designed for the plastics industry offers a combination of advantages obtainable from no other manufacturer. The pacesetting RCA 2000-watt unit (Model 2B) has set the design standard for the industry. Completely automatic, it can turn out a pound of uniformly heated preformed material at 275°F in only *40 seconds*—25% to 50% faster than non-automatic units. Operating cost (including tubes, power, maintenance, and depreciation) is as low as 20 cents per hour! Send coupon for free bulletin. Write details of your plastics-molding problem to RCA application engineers. Address: *Radio Corporation of America, Electronic Apparatus Section, Box 70-204P, Camden, N. J.*

RCA ELECTRONIC HEAT

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION . CAMDEN, N. J.

MAIL COUPON TODAY

FREE BOOKLETS ON PLASTICS PREHEATING:

RCA, Electronic Apparatus Section,
Box 70-204P, Camden, N. J.

Please send me free information on improved plastics molding with economical RCA electronic heat.

"Electronic Heat Speeds Plastics Molding"
"RCA Electronic Generator—Model 2B—For Plastics"
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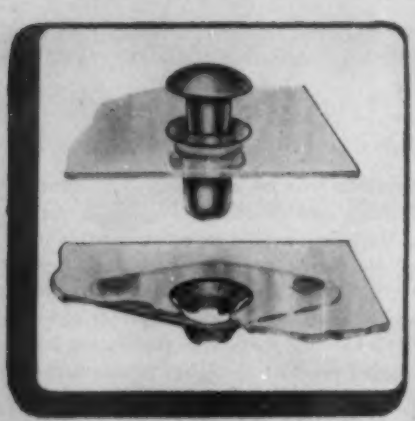
FASTEN IT FASTER WITH A SIMMONS FASTENER

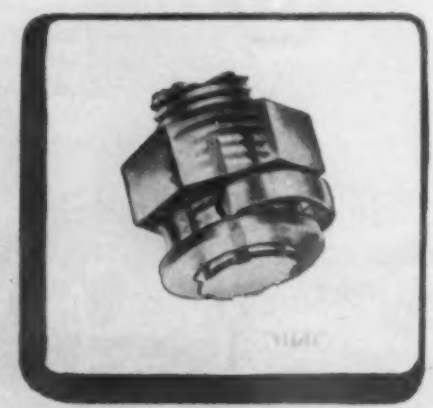


QUICK-LOCK

SIMPLIFIES ACCESS PANEL ASSEMBLIES. A 90° turn locks and unlocks it in a jiffy. QUICK-LOCK requires no special tools. Flexible mounting and tapered stud makes it ideal for assembling curved sheets and insures tight fit when locked. Stud is self-ejecting when unlocked. Minimum deflection is assured—only initial loads are carried by helical spring. Solid supports take increased loads. Let QUICK-LOCK solve your problems.

SPRING-LOCK

ONE-PIECE BLIND FASTENER. Inexpensive one-piece assembly speeds-up blind installation...requires no nuts, receptacles, lock washers or threading. SPRING-LOCK is self adjusting for various material thicknesses. Locks and unlocks with a quarter turn...can be permanently installed as blind rivet...cannot work loose from vibration. Locks with high initial load without deflection.



LOCK NUT

DOUBLE DUTY—LOCK NUT and STOP NUT. An all-purpose safety nut that reduces assembly time. One end of safety ring engages nearest serration on bolt thread. 7 Serrations provide 14 locking positions per revolution. Serrations can be cut by simple broaching operation in a fraction of the time required to drill cotter pin hole. Can be used as stop nut without serrated thread for close adjustment.

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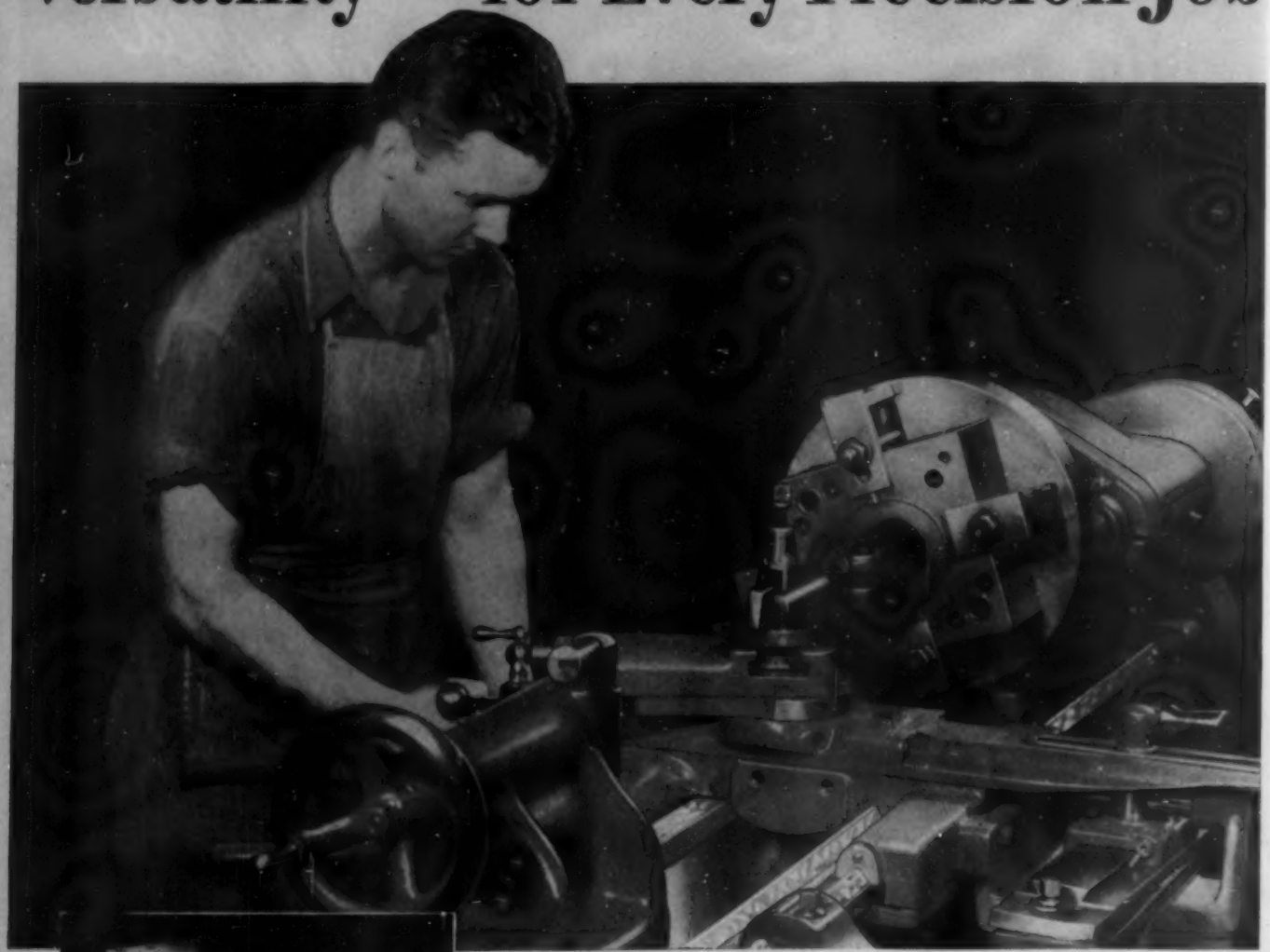
SIMMONS FASTENERS

SIMMONS FASTENER CORPORATION, 1754 No. Broadway, Albany 1, N.Y.

Versatility---for Every Precision Job



SOUTH BEND ATTACHMENTS BROADEN THE SCOPE OF YOUR LATHE WORK

A complete line of attachments and accessories simplifies tooling South Bend Lathes for many special and unusual kinds of precision work. They save time and effort, often eliminate the delay and expense of special fixtures, and greatly broaden the scope of your lathe work. Write for Catalog 77-R in which all of these attachments are illustrated and described.

The time-saving versatility which enabled South Bend Lathes to handle so many exacting precision operations in essential war industries now is a pertinent profit-making factor in the production of civilian goods. The ease and speed with which the lathe can be changed from one set-up to another, and the special attachments available to broaden the range of work, save time and reduce labor costs for the plant that has a variety of precision lathe operations to perform.

South Bend Lathes have a wide range of spindle speeds and power feeds. Full quick change gear mechanism permits instant selection of any thread cutting feed, power turning feed, or power facing-feed. Convenient, quick acting controls and easy reading graduations contribute to smooth lathe operation and efficiency.

South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9″, 10″, 13″, 14½″, and 16″ swings. Precision Turret Lathes are available in two sizes: ½″ and 1″ collet capacity. Write for new Catalog 100-D giving full descriptions of all lathes.

SOUTH BEND LATHE WORKS

442 EAST MADISON STREET • SOUTH BEND 22, INDIANA • *LATHE BUILDERS SINCE 1906*

PICTURE OF YOUR EMPLOYEES' Home Town

This view is typical of the charm and beauty of the average New Hampshire manufacturing community.

LOCATE your plastics plant in New Hampshire and this is the sort of town in which your employees will live. There will be fine stores, excellent schools and churches consistently well attended.

There will be trim dwellings with well-tended gardens. From such homes as these, the people who are with you during working hours can reach good hunting and fishing during leisure hours. Because these people live exceptionally well, they also enjoy their work.

Other manufacturing advantages in New Hampshire include: Low power rates, fine transportation to markets everywhere and a system of road patrol which makes highways usable every day in the year.

Write for your copy of our booklet on locating small and medium-sized industries: "A Plant in New Hampshire." Address Edward Ellingwood, Industrial Director, 30 State Office Building.

NEW HAMPSHIRE

State Planning and Development Commission

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Resistant to moisture and humidity changes, Phenolite used as stator insulation helps this radio condenser perform uniformly under varying climatic conditions.

RESISTS MOISTURE

Low moisture absorption of PHENOLITE improves performance of your product

In the electrical industries, Phenolite laminated Bakelite finds widespread use because of its extreme resistance to moisture and changing humidities . . . its ability to reduce dimensional changes and variations in electrical properties to a minimum.

This desirable quality accounts for its use where a tough, machinable insulation is demanded. But, because of its rare *combination* of outstanding properties, it is also readily adaptable for many more industrial applications. Light in weight (about one-half that of aluminum), it is exceptionally resilient and high in impact strength . . . is resistant to abrasion . . . possesses good machinability . . . resists heat and moisture . . . and is not affected by solvents and oils.

Find out now some of the many ways this versatile material may serve you profitably in your peacetime plans and products. Write for full information and the assistance of one of our trained engineers.

NATIONAL VULCANIZED FIBRE CO.

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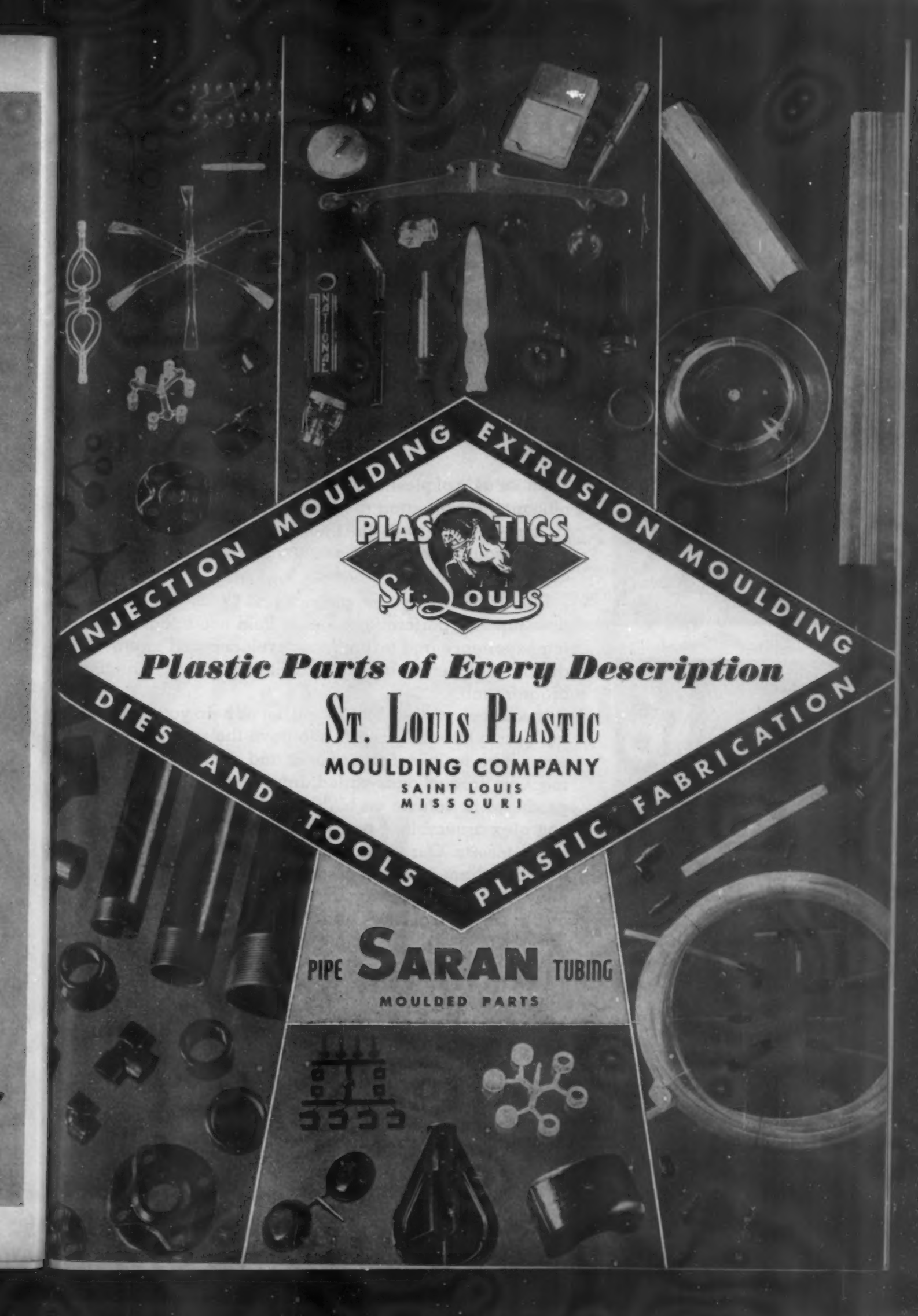
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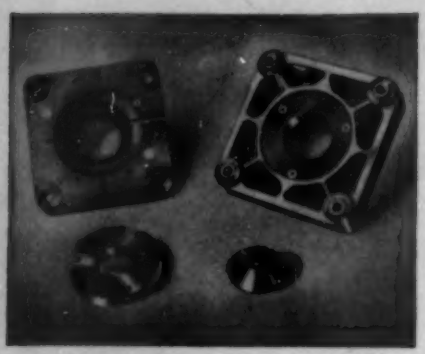

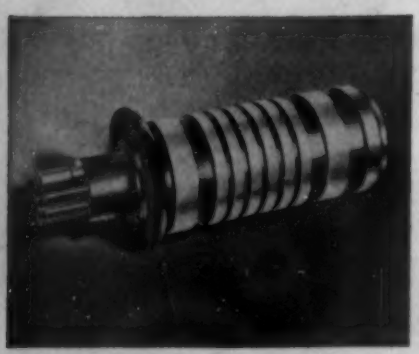

Above are examples of engineered plastics, produced by us for military requirements. Their design and production involved molding techniques that can be applied advantageously to many consumer products.

Familiar uses of plastics are being served again. Most significant, in suggesting the larger potential usefulness of molded plastics, will be their successful utilization in applications where other materials have been used by custom or tradition.

During the war years, plastics had to justify selection thru superior performance under field conditions. Molding experience and techniques developed and improved during that period are now available to you thru this organization.

If you seek product betterment, let us help you examine the possibilities in plastics. We have the most improved equipment for injection, transfer and compression molding. Our production is varied, from simple molded parts, produced in volume on high speed injection presses, to complex assemblies, transfer-molded with metal inserts. Our experience and complete facilities—from design to assembly—may benefit you. Get in touch with us. For information on our services, ask for Folder File MP11.

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"Imagineering" in Plastics

Write on your letterhead for the new Injection Molded and Extruded Plastics Catalog. Or, for detailed information about ~~MILLS PLASTIC~~* pipe, tubing and fittings, write for circulars containing data and illustrations.

*Trademark Reg.

You won't find "imagineering" in the dictionary. You will find it a working reality at Elmer E. Mills Corporation. For "imagineering" is a word we have coined to describe the imagination and engineering skill we apply to the injection molding and extrusion of plastics. Imagination breeds versatility. Engineering skill makes it work. This team of imagination and engineering skill working as one, is your assurance of a reputable molder who really knows his job. Our "imagineering" skill has flourished under wartime pressure. Its expansion will be even greater under peacetime conditions. If your product calls for plastics, let us show you how you can profitably use our "imagineering" skill. No obligation, of course.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Geon, ~~MILLS PLASTIC~~*, Saran and Other Thermoplastic Materials

153 WEST HURON STREET • CHICAGO 10, ILLINOIS

BEAUTY AND CHARM

Courtesy of Patricia Page Inc.

Molded in Colorful Plastics

by

UNIVERSAL
PLASTICS CORPORATION

NEW BRUNSWICK • NEW JERSEY

NEW! 16" DoALL ZEPHYR

for PLASTICS WOOD HARD BOARDS NON-FERROUS METALS & ALLOYS

This versatile 16" Zephyr will take work up to 10" thick and cuts at any speed from 1000 to 5000 f.p.m. Meets the demand for greater speed in a compact housing — 6 1/2 ft. high, weighs 1150 pounds, and requires 33 x 41" floor space.

MAKES EVERY SECOND PAY

Operator consults Job Selector for proper saw and speed for the material he has to cut. He installs saw in a few seconds, adjusts fingertip speed control to specified speed and is off to a flying start.

ADVANCED FEATURES

Infinitely Variable Speed • Speed Indicator • Chip Blower • 4-way Tilt Table • 2 H.P. Motor • Other exclusive features make DoALL safe and easy to operate efficiently.

A demonstration can easily be arranged through the DoALL Supply Store nearest you — or, write for new catalog.

use DoALL

BIG BROTHER OF THE 16" ZEPHYR, IS THE 36" ZEPHYR — Both Introduce A New Era in Band Sawing.

Baltimore	SA 5778	Dayton	RE 2736	Kansas City	HA 5857	Milwaukee	HO 5950	New York	WO 4-1514	Philadelphia	BAL 5850	Providence	WI 1515
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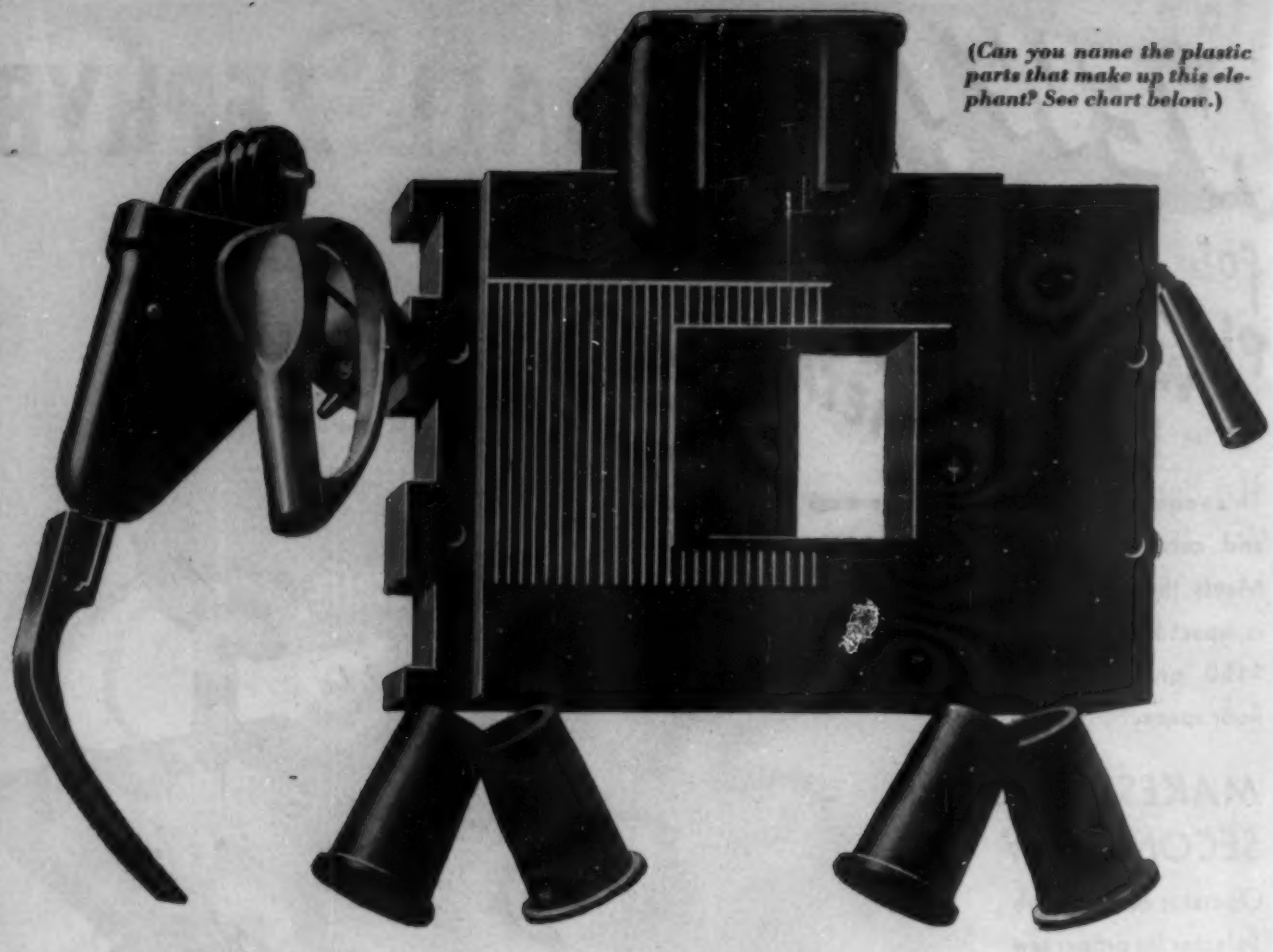
The DoALL Company — Minneapolis 4, Minnesota

Telephone Your "DoALL" Sales and Service Store

(Can you name the plastic parts that make up this elephant? See chart below.)



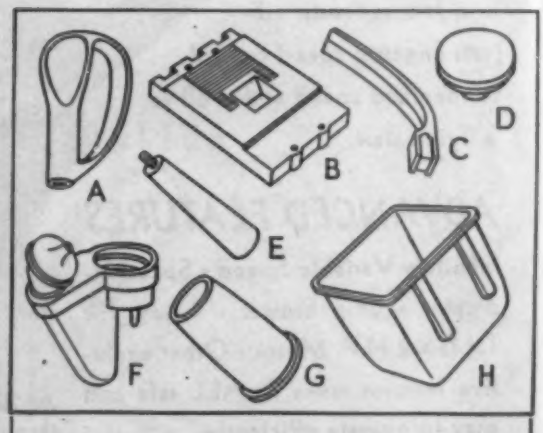
A trunkful of product ideas...

Better product ideas are going to pay off for men in industry, who take them seriously. If *you* do, please examine this elephant.

He's in a class by himself. He's assembled from eight varied plastic parts, all of them made in Continental Can Company's plastic plant at Cambridge, Ohio. His body is an electric switch box cover; his legs, sturdy outside shells for vaporizers; his trunk, a pot handle; and his ear, a shoe-tree handle.

From Jumbo's different parts you can see how well suited plastics are for *certain* products. Why not let our experienced engineers and designers determine if plastics are the solution for *your* product?

Visitors to our Cambridge plant marvel at the diversity of products made there. We're basing years of designing experience and engineering "know-how" on increased facilities and resources. So Continental naturally has a complete service to offer, one that builds customer confidence when we're asked to develop product ideas.



(A) Shoe-tree handle; (B) Electric switch box cover; (C) Pot handle; (D) Knob; (E) Handle; (F) Liquid dispenser; (G) Outside shell for vaporizer; (H) Eastman Kodak Development Tank.

Tune in: "REPORT TO THE NATION" *every week over coast-to-coast CBS Network*

CONTINENTAL CAN COMPANY, INC.

PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

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COMPRESSION • INJECTION • EXTRUSION
SHEET FORMING • LAMINATION

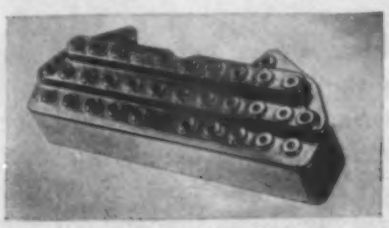
OTHER CONTINENTAL PRODUCTS: Metal Containers • Fibre Drums • Paper Containers • Paper Cups • Plastic Products • Crown Caps and Cork Products • Machinery and Equipment.

Last of the High-Pressure Men

or, Plastics March On!

You'll see the difference in your postwar plastic parts. The old idea of cramming material into the mold by main strength and brute force has vanished along with the corset.

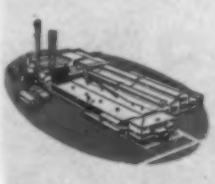
HERE'S AN EXAMPLE. We used to mold this connector plug housing in a 150-ton press. Now we use Heatronics (radio-frequency preheating) and get better results with 75 tons of pressure. Specifically, we get better cure, uniform density, better finish, less internal stress, less or no washing of inserts and all-around improvement of properties.



OTHER MOLDERS will go in for Heatronics more extensively, of course. *The point is, we have had substantial experience with it for the last year and a half*—have been building our installations since RCA delivered us the first unit in the industry. *Our pioneering is behind us*—just as with every other development that has come along since we started molding back in the earliest days of plastics. We can show you applications to prove it.

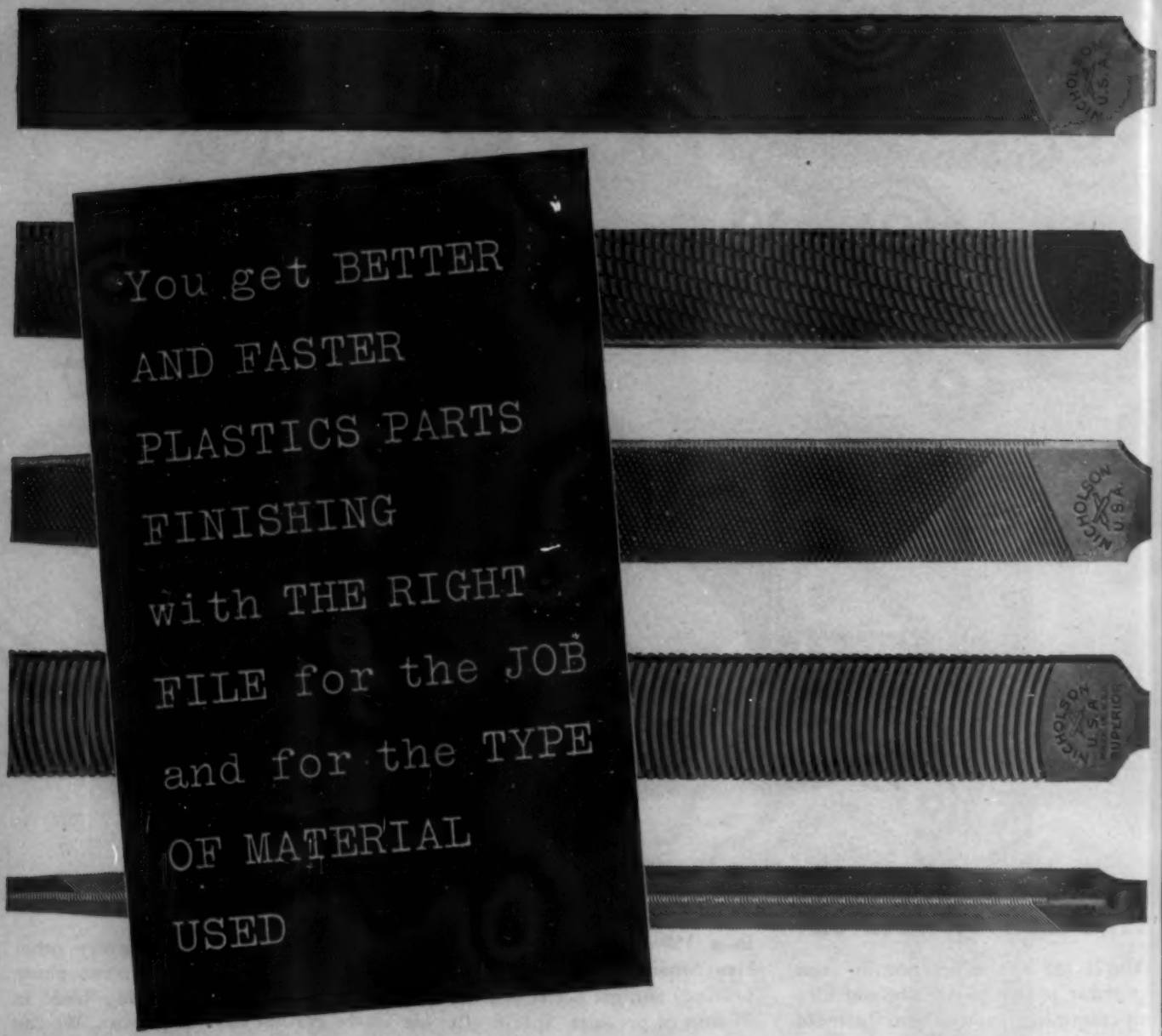
IN FACT, we can prove plenty of things about plastic molding, if you're interested. Now! Ask for a Kurz-Kasch engineer!

Kurz-Kasch



For over 28 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City



THE variety of plastics products, plus the variety of plastic *materials* or compositions, has become so great that the range of files—for flash removal, finishing and parts fitting—has become correspondingly wide.

Intricate parts, with all sorts of edges, angles, slots, grooves and holes, mean variety in the *shape* of files. Hard, soft, shreddy materials, and laminated stocks, bring out the need for different *cuts* of files. . . . Sharp, high-topped teeth, for instance, on highly abrasive compositions. Wide-gulleted teeth to facilitate clearing where materials have a tendency to clog. Milled curved teeth for rapidly "shearing" away stock and leaving a smooth finish at the same time.

Nicholson has always gone beyond just making good files. Here the study of the file needs of new and growing industries is a never-ending one. *When ordering Nicholson files from your mill-supply house, state kind of plastics they are for, in addition to general file shape, size and cut, and Nicholson will supply files with correct teeth.*

NICHOLSON FILE CO. • 44 ACORN STREET, PROVIDENCE 1, RHODE ISLAND
(In Canada, Port Hope, Ont.)

NICHOLSON FILES FOR EVERY PURPOSE

"IT'S ALL *Velon** IN THIS PICTURE!"

And VELON can be prominent in your product's picture!

Velon is a material so amazingly versatile that it can be used for upholstery fabric on transportation seating, or the finest custom-made furniture; for shoes, hats, belts, lampshades and draperies, electrical insulation and conveyor belts. As film, *Velon* makes shower curtains, protective packaging material, yes, even babies' pants —while *Velon* screening will bring a new color note to interior and exterior design.

The secret of this versatility lies partly in *Velon's* infinite possibilities for pattern, texture and style. Colors range from delicate pastels through clear, bright tones, to deep, rich shades woven of threads which can be transparent, translucent or opaque.

And to complete the picture, *Velon's* colorful beauty is above all practical! Dirt and grease cannot cling to *Velon's* nonporous threads, acids and alkalis won't stain it. A dampened cloth brings *Velon* back fresh and bright as new.

Velon is non-inflammable and non-heat-conducting. Exposed to the sun it will neither fade nor change color.

Now is the time to start planning with *Velon*, now is the time to explore its many new possibilities. Write Firestone, Akron, for details.

BEST TODAY... STILL BETTER TOMORROW

LISTEN TO THE VOICE OF FIRESTONE MONDAY EVENINGS OVER NBC

Firestone

*TRADE MARK

The importance of selecting the right material . . . and molder

Selecting the right material is the first serious problem to be overcome after preliminary drawings of a part or product have been made. It involves careful research on all of the materials available and a painstaking matching of their properties with the requirements of the job. Mechanical, electrical, optical, thermal, fabricating and molding properties; stability and the effect of chemicals, and those general characteristics such as moisture absorption, solvent action, aging and weathering, taste and odor have to be explored for their effect on the part or product from design to actual performance.

The problem of selection is not an easy one in these days of rapid and glamorous advance . . . particularly in plastics. New compounds are constantly emerging. The properties of plastics such as Cellulose Acetates, Acrylics, Phenolics, Polystyrene, and Vinyls, for instance, differ a great deal. Research on rubber is continuing and new synthetic

formulas are being developed. When natural rubber is available in quantity again, we will have a still greater range of compounds.

From appearance to performance, the proper material depends on the job your part or product has to do. A plastic, hard or soft rubber, a metal, or a combination of two or three of them may be best.

Complete Service

Here at the Vulcanized Rubber and Plastics Company, we have the chemical and physical research and testing laboratories and staff to help you find that right material. And we have a wealth of experience in fabricating molded forms. Starting over sixty years ago with hard rubber, one of the first plastics, we have constantly sought to convert any new development in plastics to the mutual benefit of our customers and ourselves.

Our engineering staff will be glad to help you

Just tell us where your part or product goes to work or give us the drawing and specifications. If we should find that the part or product doesn't belong, economically or physically, in any one of the wide range of plastics, hard rubber, soft rubber, or molding methods that we are set up to handle, we will frankly say so and recommend what we think is best. If you would like to have an engineer call to discuss your application, please write Dept. C.

Vulcanized Rubber and Plastics Company

formerly The Vulcanized Rubber Company

Manufacturers of Rubber and Molders of Plastics

General Offices: 2 East 29th Street, New York 16, New York Works: Morrisville, Penna.

Plastics? Fine. But are you sure Hard or Soft Rubber won't do it better?

Just as it made sense for us, with our molding experience, to go into the new plastics, it also made sense to continue our research and fabricating on the older plastics . . . hard and soft rubber. In many applications rubber works far better than any of the new plastics. For instance, in water meter applications, none of the new plastics have the over-all properties of hard rubber, particularly the dimensional stability and high resistance to moisture and solvents, that would enable them to be used as universally. The same reasons hold true for its choice in many applications in the electrical field where it withstands submersion and exposure to gases much better than newer plastic materials.

FABRICATING AND MOLDING DATA: On up-to-date laboratory equipment like this 150 ton fully automatic hydraulic press the best method for your part or product is determined. In this versatile machine, research on compression and transfer molding is done on both plastics and rubber compounds.

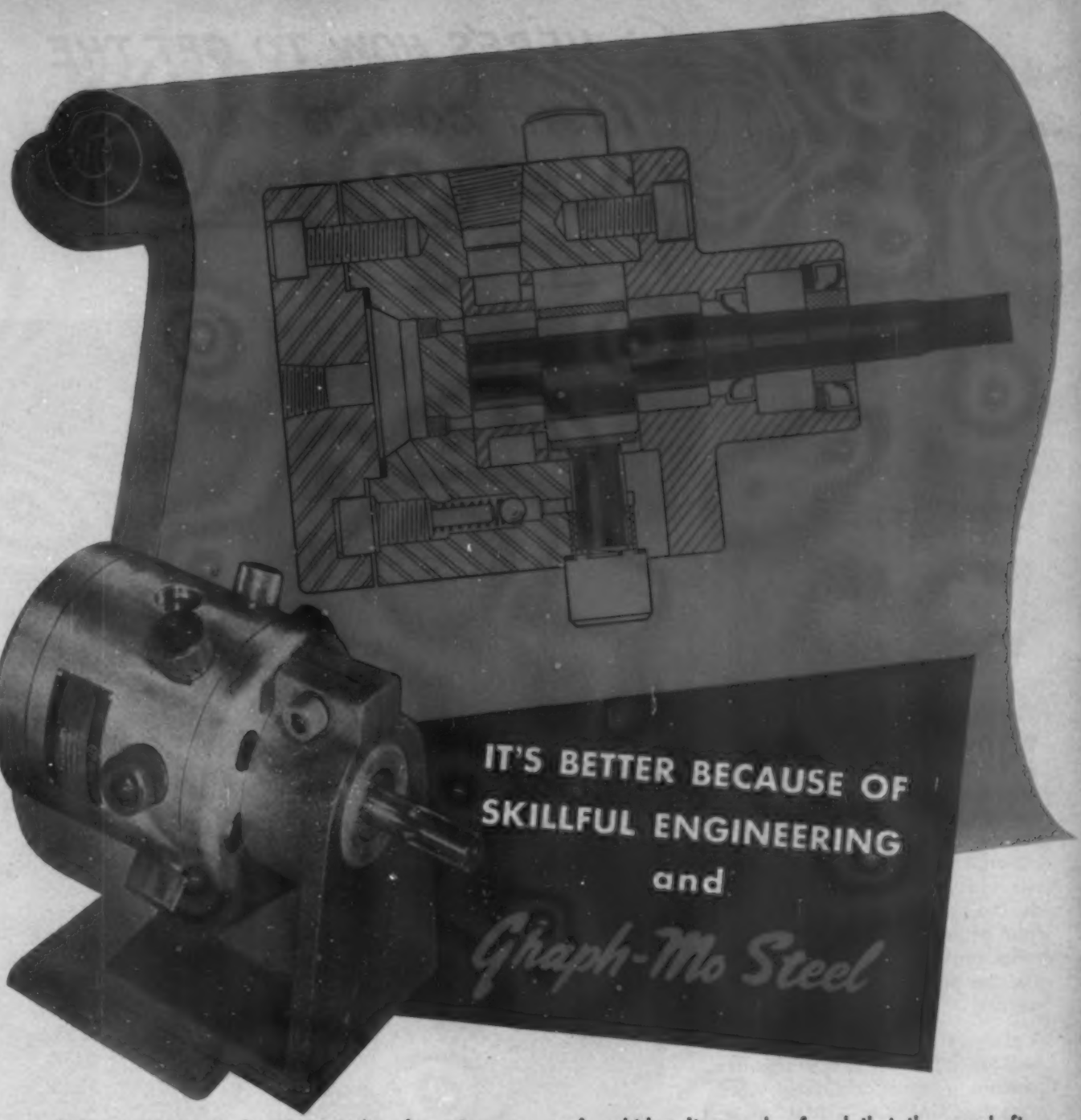
QUALITY CONTROL: Section of the semi-scale plant in our laboratory which duplicates the machines in our plant, where continual research to improve the fabricating method of your part or product is carried on and materials tested for behavior under operating conditions.

Assembly—

In addition to molded plastics our metal division enables us to offer a complete service which is adaptable to your exact specifications, resulting in greater convenience and economy for you. For post-war plastics think of Bridgeport.

BRIDGEPORT MOULDED PRODUCTS, INCORPORATED

BRIDGEPORT CONNECTICUT



Still going strong after 18 months of continuous service without repairs, is the record being chalked up by a Seco Fluid Power Unit made by the Simplex Engineering Company, Zanesville, Ohio. This record is due to skillful engineering and the use of Graph-Mo Steel for parts that are subjected to severe wear.

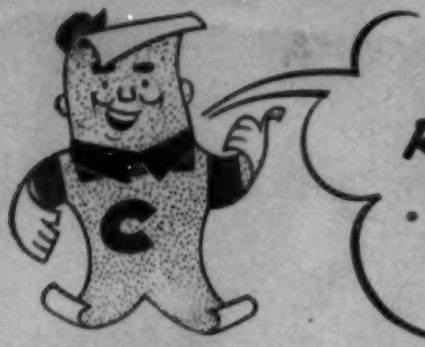
Graph-Mo Steel is used for the camshaft and the hollow piston of the sleeve assembly. Of all the steels tried only Graph-Mo met the exacting demands of Simplex engineers. It was chosen because it has reliable response to heat treatment with only a minimum amount of distortion. This eliminated the problem of thin walled buckets cracking after quenching and it reduced grinding operations on the camshaft. Graph-Mo was able to resist the severe abrasive action imposed upon these parts because it contains an excess of carbon in the form of carbides. It was also found that the camshaft and buckets could be made faster from Graph-Mo Steel than from competing grades because it is remarkably free cutting with the short chip and smooth finish of cast iron.

You can build dependability into your products and speed their production too, if you make them from Graph-Mo an oil hardening steel, which is one of the five famous Timken Graphitic Steels. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

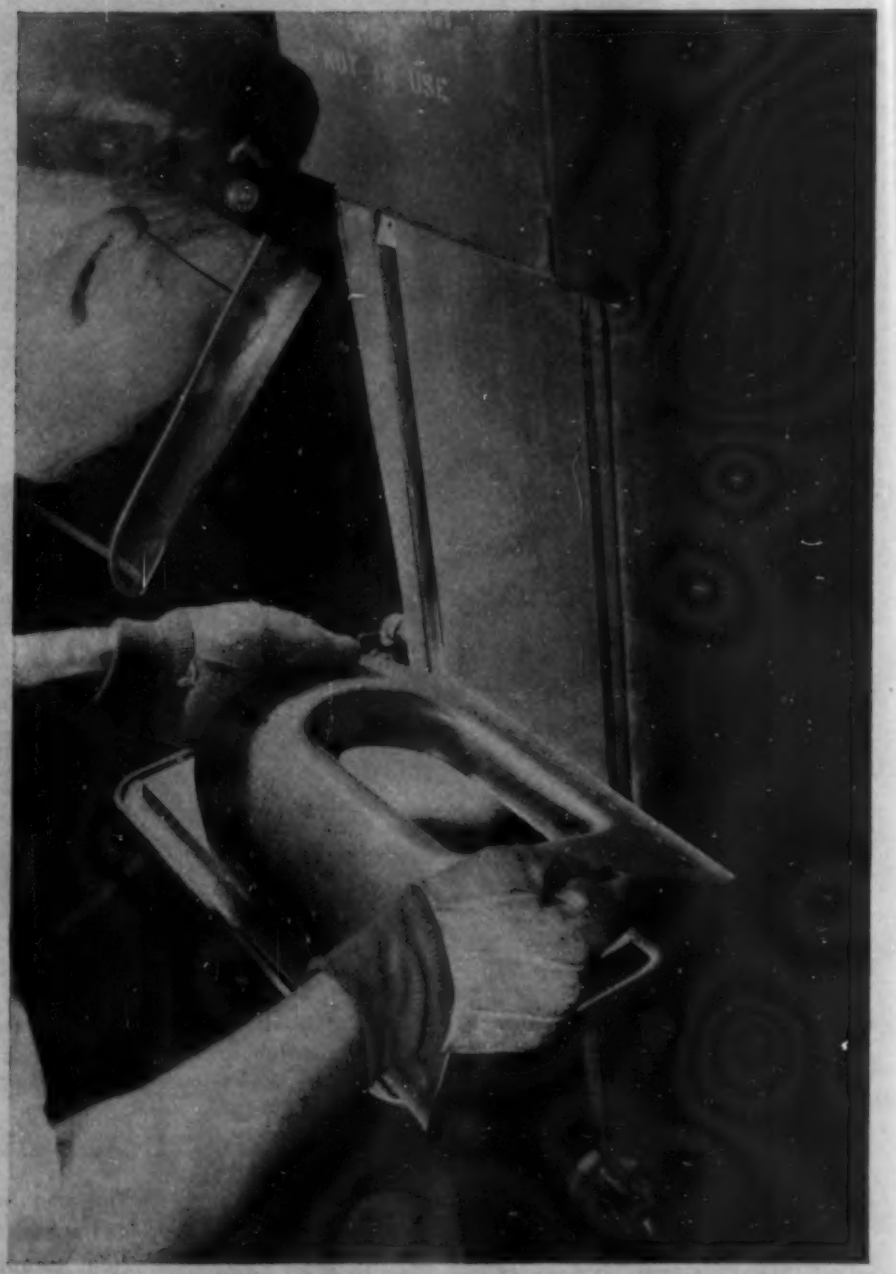
GRAPHITIC STEELS



HERE'S HOW TO GET THE RIGHT COATED ABRASIVE —everytime!

NOW the Coated Abrasives by "CARBORUNDUM" have the specifications clearly and simply marked on *both* the labels and backing materials! Thus, when the material is in use in the shop, you can tell what to requisition from the stockroom. And the stockroom, from either labels or backing material can tell at a glance what to ask the purchasing department to reorder.

A glance at the picture of label and backing will tell you how this new marking system for Coated Abrasives by "CARBORUNDUM" makes it easy to identify, specify and order this popular line of coated abrasive products. The Carborundum Company, Niagara Falls, N. Y.



THERE IS A PRODUCT BY

CARBORUNDUM

TRADE MARK

FOR EVERY ABRASIVE APPLICATION

("CARBORUNDUM" is a registered trade mark of and indicates manufacture by The Carborundum Company)

Why is Cellulose Nitrate Preferred for Shoe Heel Coverings?

Women's shoe manufacturers specify cellulose nitrate heel coverings because they are tough and wear-resisting . . . proof against scuffs and scratches. They usually outlast the leather soles and heels.

NIXON C/N (Cellulose Nitrate) is a tough plastic . . . easily fabricated and cemented . . . moisture-resistant . . . colorful. It is practical to use for many products.

NIXON Plastics

NIXON C/N
Cellulose Nitrate

NIXON C/A
Cellulose Acetate

NIXON E/C
Ethyl Cellulose

NIXON NITRATION WORKS • NIXON • NEW JERSEY

REPRESENTATIVES:
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NORTHWEST PLASTICS INDUSTRIES
Portland, Oregon • Seattle, Washington

HOBBS GLASS, LTD., Canadian Distributors
Quebec • Montreal • Ottawa • Toronto • Hamilton • Brantford • London
Windsor • Winnipeg • Moose Jaw • Saskatoon • Vancouver • Victoria

KEEP YOUR PRODUCTION "LIGHT ON ITS FEET"!

Speed Up Tooling Shifts With Walker-Turner MACHINE TOOLS

Walker-Turner Light Machine Tools reduce your re-tooling problems to a minimum. Here's why:

(1) Quickly shifted from one operation to another.

(2) Ideal for special tooling set-ups—precluding need for high-priced special machines of limited usage.

(3) Rugged, safe and simple to operate.

(4) Low in price and in power consumption.

Complete catalog on request.

WALKER-TURNER COMPANY, Inc.
PLAINFIELD NEW JERSEY

METAL CUT-OFF MACHINE
Universal head travels 10½" on gliding ram; patented, geared motor gets shaft closer to work, smaller blades.
$374.50 f.o.b. Plainfield, N. J.
With 2 or 3 H.P. Motor, less base.

14" BAND SAW
Back-gearing and cone pulley gives high speeds for wood (up to 4630 s.f.m.), low speeds for metals (as low as 60 s.f.m.). Also made in 16" model.
$127.50 less base and motor.

20-INCH DRILL PRESS
Spindle speeds, 260-5200 r.p.m.; capacity, ¾" in steel, 1" in cast iron.
$255.00 less motor.

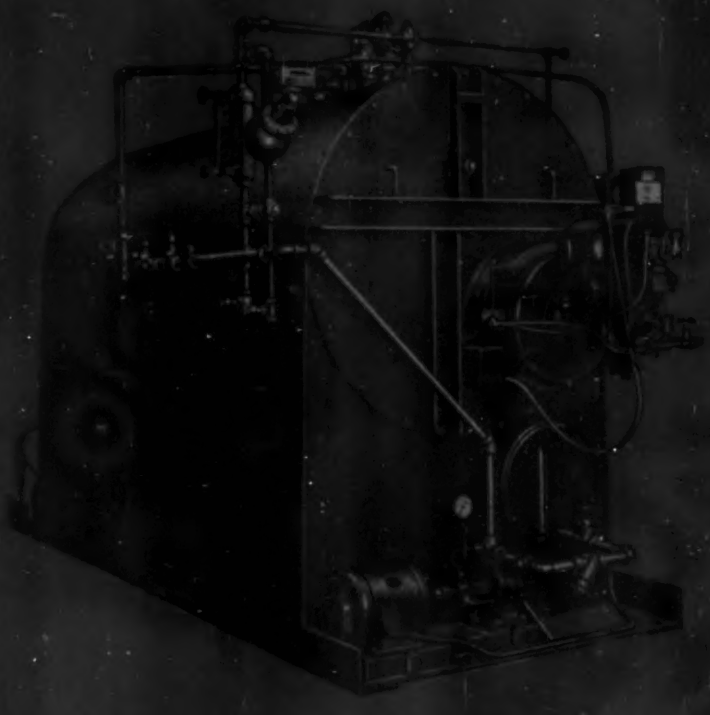
RADIAL DRILL
Spindle speeds, 160-8300 r.p.m.; drills to center of 62" circle.
$352.50 less base and motor.

walker-Turner COMPANY, INC. PLAINFIELD, N.J. U.S.A.

MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

PROUD TO BE A VETERAN



Serving the U. S. Navy under every imaginable condition has taught us many things about automatic boiler design that, supplemented by our 65 years experience, make the Dutton Econotherm the outstanding automatic, "packaged" boiler on the market. You are assured maximum in efficiency and economy because the Econotherm has met Navy tests that make ordinary boiler room requirements seem like child's play! Because of this experience, we can offer you a boiler that is ready to set down and run without costly or lengthy installation work. All gases scavenged — no chimney necessary other than small pipe to carry flue gases through roof. Entirely self-contained and completely insulated — faster firing and steaming — compact enough to produce twice the steam in half the usual space — meets maximum steam withdrawals with complete safety — and requires a minimum of supervision.

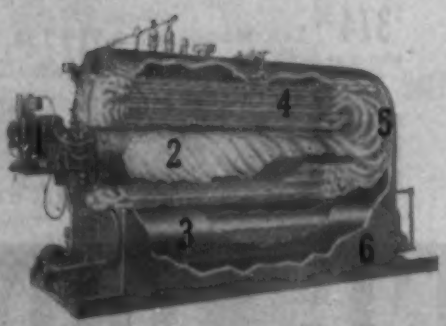
SOME OF THE FEATURES THAT BROUGHT OVERWHELMING NAVY APPROVAL!

Dutton

1 Oil or gas fired — automatic ignition.

2 Quick firing exclusive Dutton Rotary Combustion.

3 Condensate return tank in casing.



4 Three Pass Induced Draft system.

5 Completely insulated.

6 Compact, streamlined casing.

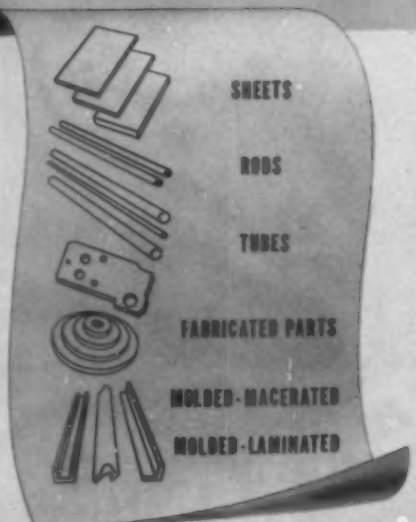
ECONOTHERM

AUTOMATIC STEAM GENERATOR

DUTTON ECONOMIST HIGH PRESSURE BOILERS
DUTTON AUTOMATIC VERTICAL BOILERS
PRESSURE VESSELS • CONDENSERS
HEAT EXCHANGERS

THE C. H. DUTTON COMPANY • 618 Gibson Street, Kalamazoo, Michigan

Using Corrosion Resistance, Strength, and Machinability



MOVIE FILM carriers are an excellent example of using plastics where plastics belong.

The film carrier illustrated is only one of many types made from Synthane laminated plastics. Synthane is well-suited for the job because it stoutly resists the corrosive action of developing solutions.

The teeth, though small, must be strong and accurately indexed. They are easily milled from Synthane.

If you have any application for which laminated plastics seem to be indicated, let us know about it—*before* you design, if possible.

Our development engineers want to help you fit the job for plastics and fit the plastics for the job. Design, materials and production should be eyed as one problem if performance and costs are to be satisfactory. Synthane's help includes design, selection of the right material, and fabrication by men who know plastics.

SYNTHANE TECHNICAL PLASTICS • DESIGN • MATERIALS • FABRICATION

SYNTHANE

SYNTHANE CORPORATION OAKS, PENNSYLVANIA

What'll You Have!

Dielectric? Synthane is an excellent electrical insulator. Dielectric strength is high, power factor and dielectric constant low. What makes Synthane the useful dielectric it is, is its strength and the comparative ease with which it can be punched or machined into the variety of parts needed on radio and electrical equipment.

Radio Socket Base

Strength? Synthane seldom is asked to compete with metals and alloys in strength. It is exceptionally strong for its weight and will compare favorably with metals for strength on a weight basis. Synthane is a member of that family of plastics highest in tensile, compressive, flexural and impact strengths.

Coupling Cross

Light Weight? One of the most important properties of Synthane is its light weight. Although Synthane weighs only ½ as much as aluminum its strength is ample for electrical applications and sufficient for most mechanical uses. Light weight plus other virtues accounts for its wide use in aviation.

Vee Belt Pulley

Anti-friction? Two grades of Synthane laminated have anti-friction and anti-wear characteristics built in, due to the incorporation of a special graphite. Available in sheets, rods, tubes and in special shapes and fabricated parts. Possibilities for this material are worth investigating.

Ball Bearing Retainer

Corrosion Resistance? Perhaps you can take advantage of Synthane's immunity to most oils and solvents, Synthane's resistance to various concentrations of acids and salts. Often used because it has longer life per dollar than other materials, including cost of replacement.

Plating Tank Parts

Combination? Are you looking for two, three, four or even more properties combined in one material? Synthane may do the trick. It has all of the advantages above plus hardness, abrasion resistance, stability under temperature or moisture conditions, ease of machining, and many others.

Molded Gears

SYNTHANE CORPORATION, OAKS, PENNA.

Representatives in all principal cities

Plan your present and future products with Synthane Technical Plastics • Sheets Rods • Tubes • Fabricated Parts • Molded-laminated • Molded-macerated

SYNTHANE

It's easy to find yes-men. You can hire them in any field, and they are not restricted to the movie business by a long shot.

We have found that it sometimes pays to say "NO". On several important occasions which we can call to mind, it has been our sad duty to turn down a customer who wanted us to make miles, yes even hundreds of miles, of a particular profile. We were not being capricious. We just knew from minimum testing, that the job was not right, that the materials were not adequate.

From our long experience in extruding plastics—we were the first in the business, remember—we have built up a backlog of experience upon which we draw when we are confronted with plastics production and application questions. Since we extrude all thermoplastics, we think that our advice is unbiased. So do our customers, who number among themselves many of America's leading industries and foremost industrialists.

Although we prefer to say "yes", when we say "no" to a job, we mean it and we stick by it. If you would like to do business with a company which is not afraid to say "no", even when it might mean that we were losing an immediate profit, try MACOID.

We also do injection molding.

DETROIT
MACOID
CORPORATION
12340 Cloverdale Ave.
Detroit, Michigan

SOCIETY OF THE PLASTICS INDUSTRY · SPI

ORIGINATORS OF
DRY PROCESS PLASTIC EXTRUSION

WE ARE PREPARED FOR PEACE!

Following several years of war production, we now return our facilities and experience to the problems of peace. At Northwest we are large enough, yet flexible enough to give a personalized molding, engineering, and development service to all of our customers. This type of service has made Northwest one of the most progressive plastics molding concerns in the United States.

Our modern engineering and laboratory facilities, combined with our many molding methods, assure you that your job will be carried through to your complete satisfaction.

Phone or write us today. Address Northwest Plastics, Inc., 2233 University Avenue, St. Paul 4, Minnesota.

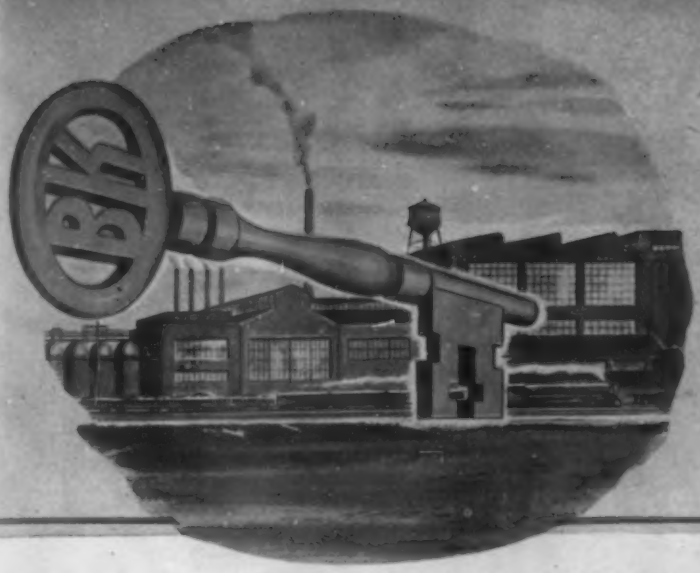
ARMY ORDNANCE AWARD

FOR MERITORIOUS PRODUCTION

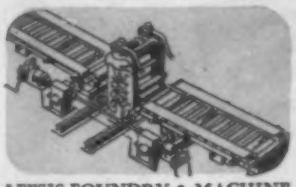
Compression molding • Transfer molding • Injection molding • Extrusion molding
Modern Tool and Die Department • Finishing, Fabricating and Assembling Department
Laboratory for Development and Production Control • Engineering and Product Design

SOCIETY OF THE PLASTICS INDUSTRY SPI

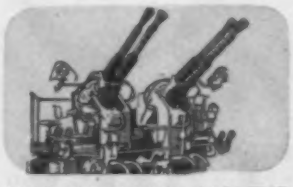
NORTHWEST PLASTICS inc.



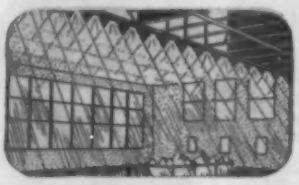
The Key Called "KNOW-HOW!"



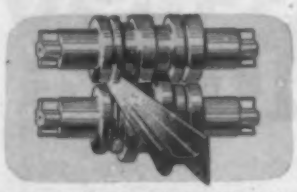
LEWIS FOUNDRY & MACHINE DIVISION . . . Rolls and rolling mill machinery.



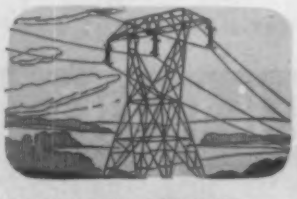
MARTINS FERRY and SPECIAL ORDNANCE DIVISIONS . . . 40 mm anti-aircraft gun mounts and mechanisms.



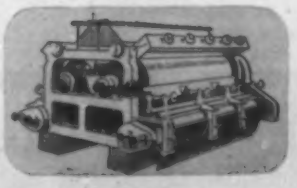
BLAW-KNOX SPRINKLER DIVISION . . . Automatic sprinkler and deluge systems.



PITTSBURGH ROLLS DIVISION . . . Rolls for steel and non-ferrous rolling mills, etc.



BLAW-KNOX DIVISION . . . Chemical and process equipment, steel plant equipment, construction machinery, transmission and radio towers, steel grating, Standard buildings and hangars, etc.



BUFLOVAK EQUIPMENT DIVISION . . . Food processing equipment, evaporators, dryers, distillation and solvent recovery equipment, grey iron castings, etc.

IT unlocks many doors . . . solves many a pressing problem. You may have the key yourself. But, if not . . .

. . . consider Blaw-Knox. Think of its engineering skills accumulated through years of peace and war, its vastly "stepped-up" resources of experience, knowledge and production facilities.

The listing under the various Divisions of Blaw-Knox shown here represents but a small fraction of Blaw-Knox products and services. But it does hint at specialized knowledge in many fields, at research and laboratory facilities, at modern plants, equipment and methods . . . at an engineering background of great breadth and scope.

If what Blaw-Knox has to offer lies within your range, it may well help to provide the answers you need—the hedge you need—against future uncertainties. We ask for an opportunity to discuss this with you.

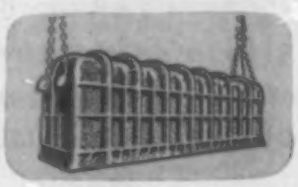
Ask for Blaw-Knox Illustrated Products Book 2055-B

BUY VICTORY BONDS

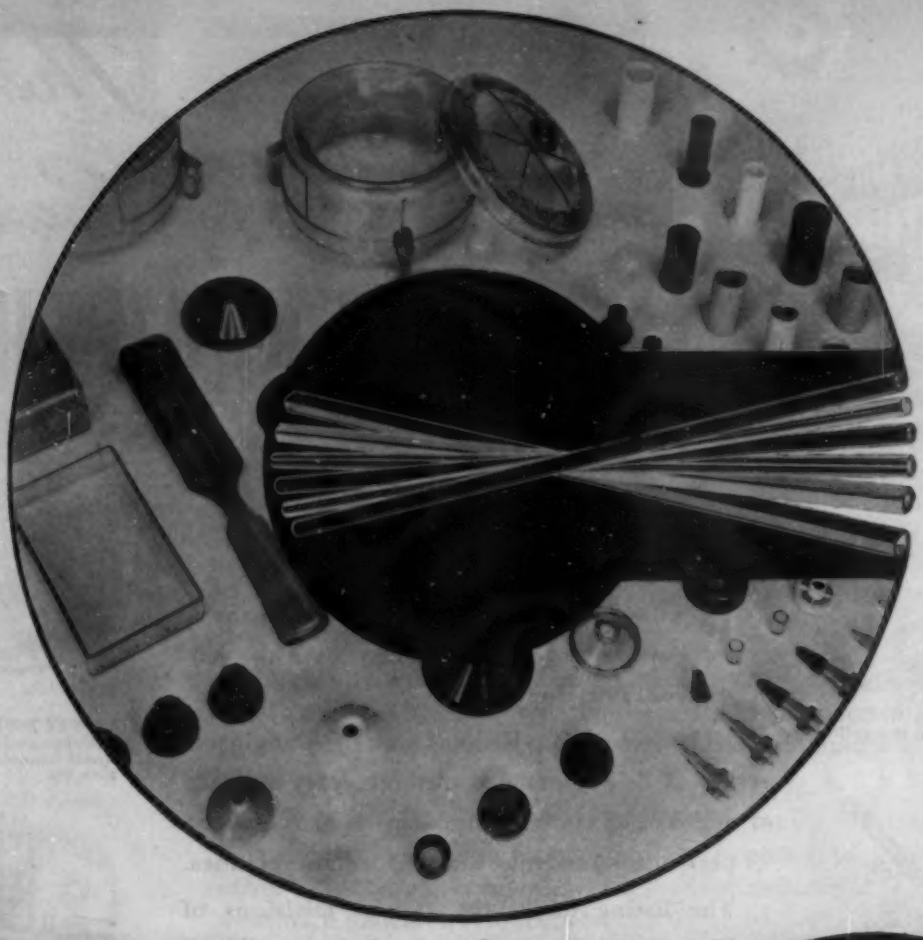
POWER PIPING DIVISION . . . Prefabricated piping systems, functional hangers, vibration eliminators, etc.

CHEMICAL PLANTS DIVISION . . . Chemical and process plants from laboratory to production.

NATIONAL ALLOY STEEL DIVISION . . . Heat and corrosion-resistant alloy castings.



UNION STEEL CASTINGS DIVISION . . . Steel and alloy castings for steel mills and railroads. Gear blanks, pump casings and castings for general industrial usage.



CELLUPLASTIC ... The Mark of DEPENDABILITY

CONFIDENCE is the Keynote wherever CELLUPLASTIC moldings are concerned . . . Confidence on the part of the buyer, who knows that the specifications are rigidly carried out—and confidence on our part that our Staff has the "know-how" to produce the best in Thermoplastics.

Confidence, too, that our plant capacity can economically handle great capacity. Injection moldings up to 9 ounces per shot; Extrusion moldings practically "made by the mile", in an endless variety of shapes and colors.

Also manufacturers of plastic shatterproof CLEARSITE containers

for EXTRUSION and INJECTION MOLDING

An Expert Technical Staff at Your Service!

CELLUPLASTIC CORPORATION

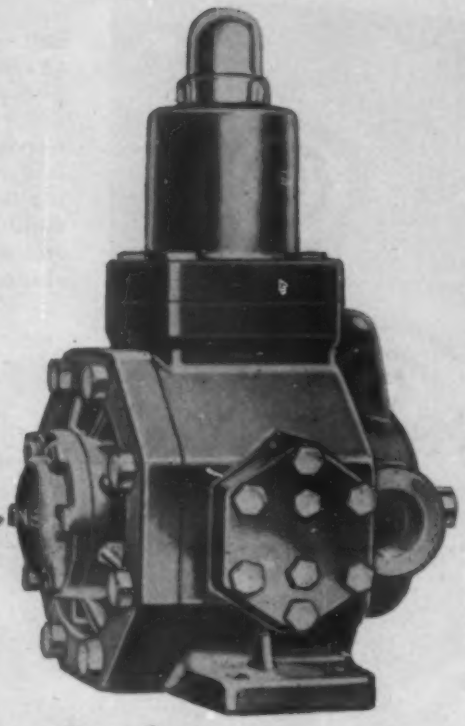
PLASTIC CONTAINERS AND PLASTIC PRODUCTS

44 AVENUE L NEWARK 5, N. J.

NEW YORK OFFICE—630 FIFTH AVENUE WEST COAST CONTAINER SERVICE COMPANY LOS ANGELES 27, CAL.

Variable volume

OIL HYDRAULIC PUMPS



50 to 1000 lbs. pressure

1 to 30 gal. per minute from one pump

RACINE "Variable Volume" Pumps supply only the needed volume of oil—no more—no less. Volume control can be regulated automatically or manually.

This equipment supplies the exacting needs of operations requiring variation in volume and pressure. Because both these features are incorporated in a single pumping unit, the cost of the initial installation is less. Continued savings are provided through lower horsepower consumption in daily service. Correct design, precision workmanship, rugged construction and overload capacity insure long life.

RACINE "Variable Volume" Oil Pumps are built in three capacities: 12, 20 and 30 gallons per minute, all designed to deliver pressures up to 1000 lbs. P.S.I. Let our experienced factory engineering staff and field engineers supply recommendations for developing and improving your oil hydraulic circuits.

Write today for our catalog P-10-C. At the same time outline your problem. Full information will be supplied without cost to you.

RACINE TOOL AND MACHINE COMPANY
1759 State Street Racine, Wisconsin, U. S. A.

RACINE ECONOMIES

- ★ No oil heating loss through pumping excess oil.
- ★ Relief valves are eliminated, the Pump varies the volume.
- ★ Less horsepower required—because no excess oil is pumped.
- ★ Tilted multiple vanes of special design reduce ring and rotor wear.

SLEEVE TYPE VALVES REDUCE CIRCUIT SHOCKS

RACINE's complete line of Oil Hydraulic Valves utilize a sleeve design. When these valves are operated, the flow of oil is gradually measured or tapered off—shock present in valves with quick closing ports is eliminated.

Sleeve design also provides the advantage of variation in porting arrangements. RACINE Control Valves in ⅜" to 1½" standard pipe sizes. Manual, mechanical or electrical control devices can be provided.

The Production Saws of Modern Industry

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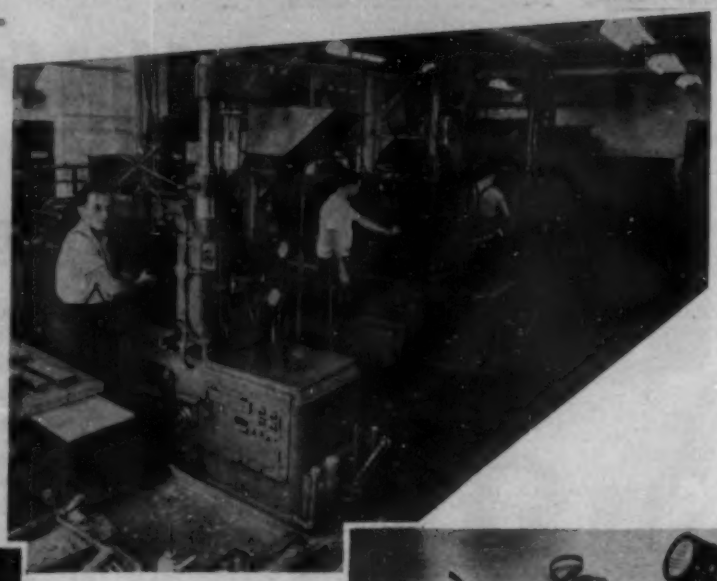
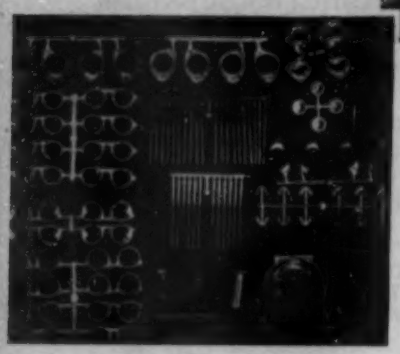


Left—A section of the molding department of the American Optical Company, Southbridge, Mass., showing (left to right) a 4-ounce and two 6-ounce Lester machines.



Left and Right—Goggles, optical instrument parts and a respirator made by American Optical on Lester injection molding machines.

But speed is not the only Lester advantage observed in this 112-year-old firm's molding plant. One of the Lesters, a 6-ounce machine, is equipped with a 4-ounce injection cylinder providing 30,000 psi, injection pressure to produce a particular molding which must be extremely dense with a very smooth surface. What better endorsement could there be of the Lester statements that applied pressure, effectively held in the cavity, gives the best results?

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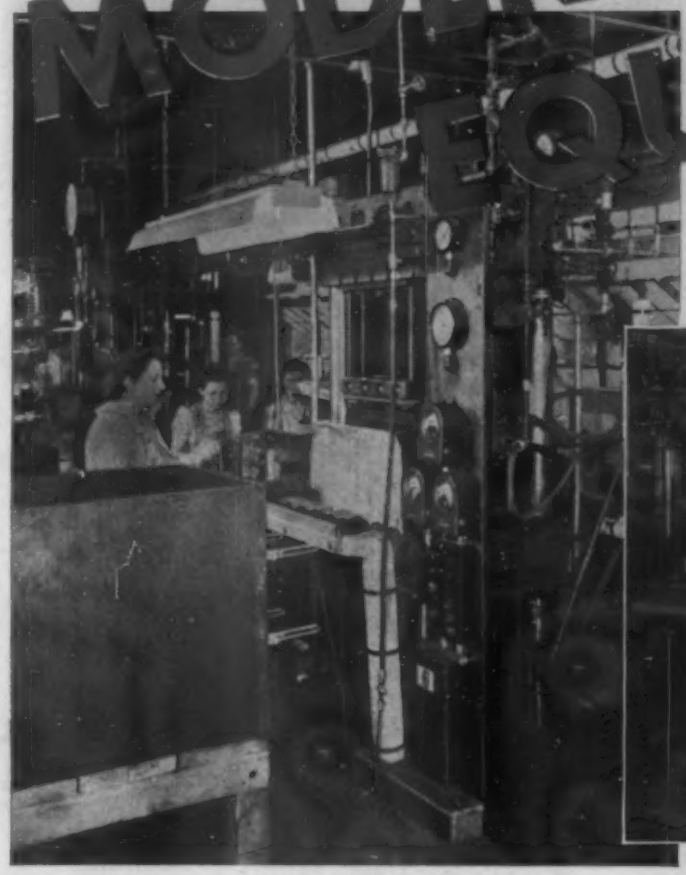

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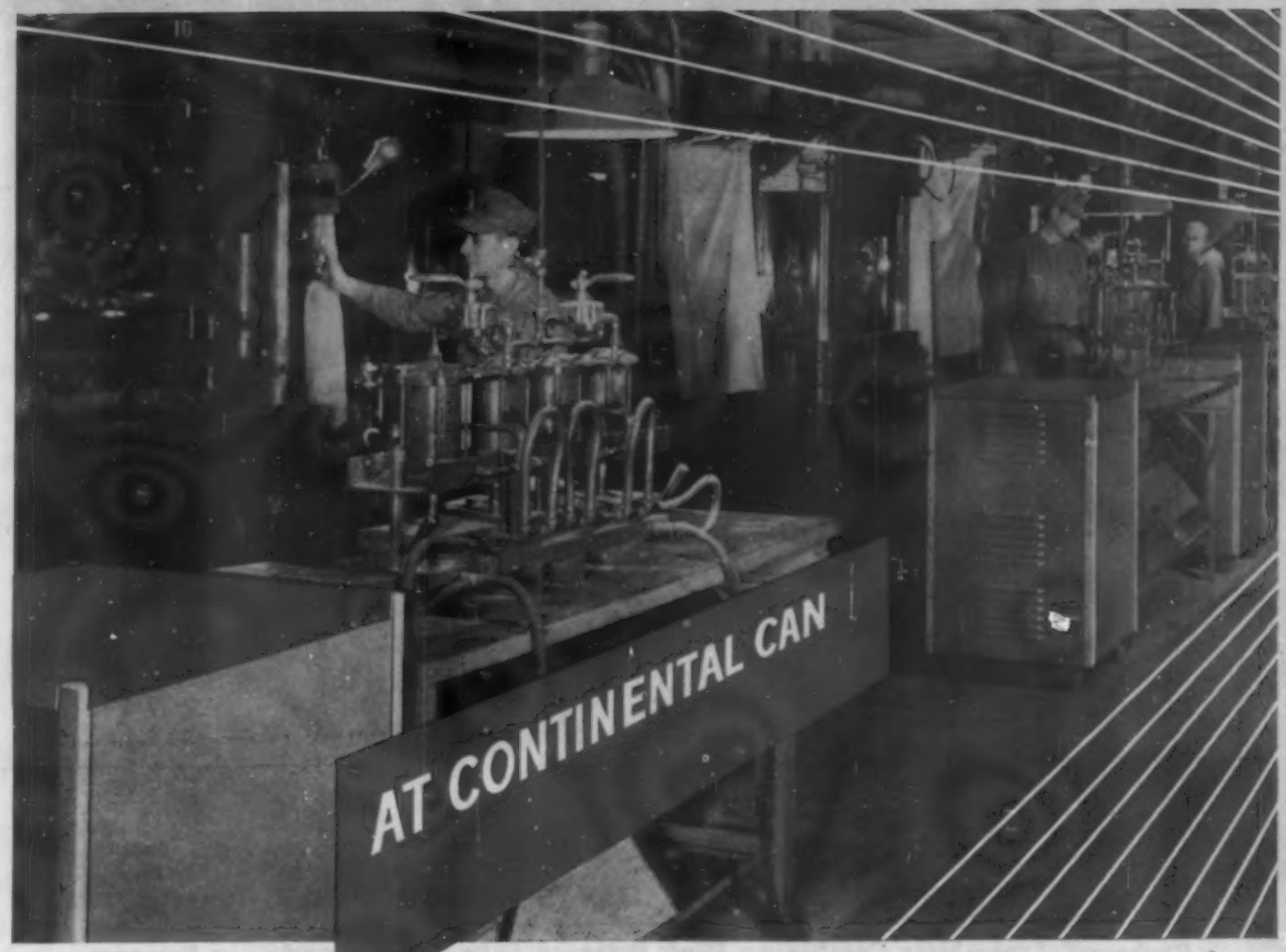

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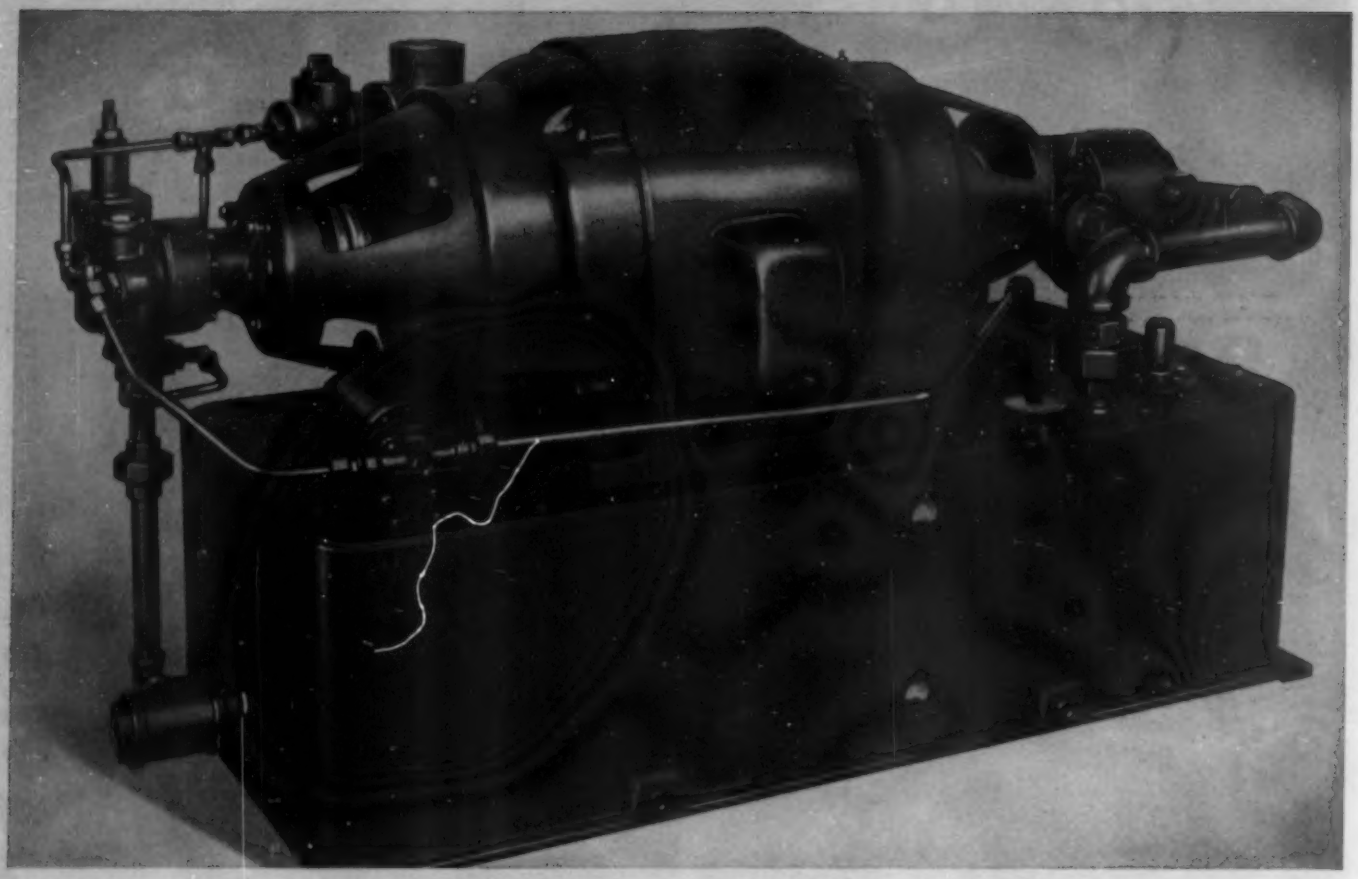

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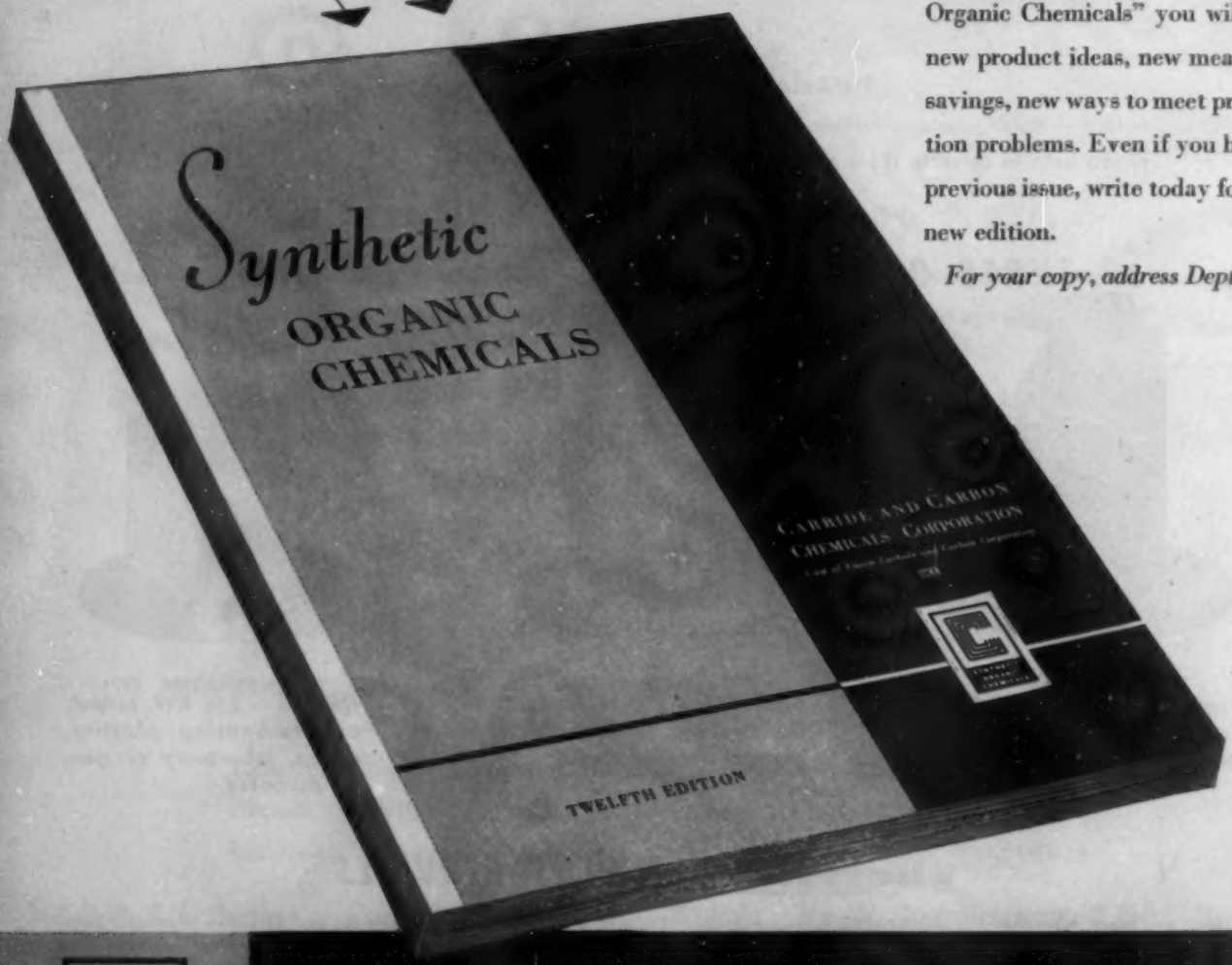

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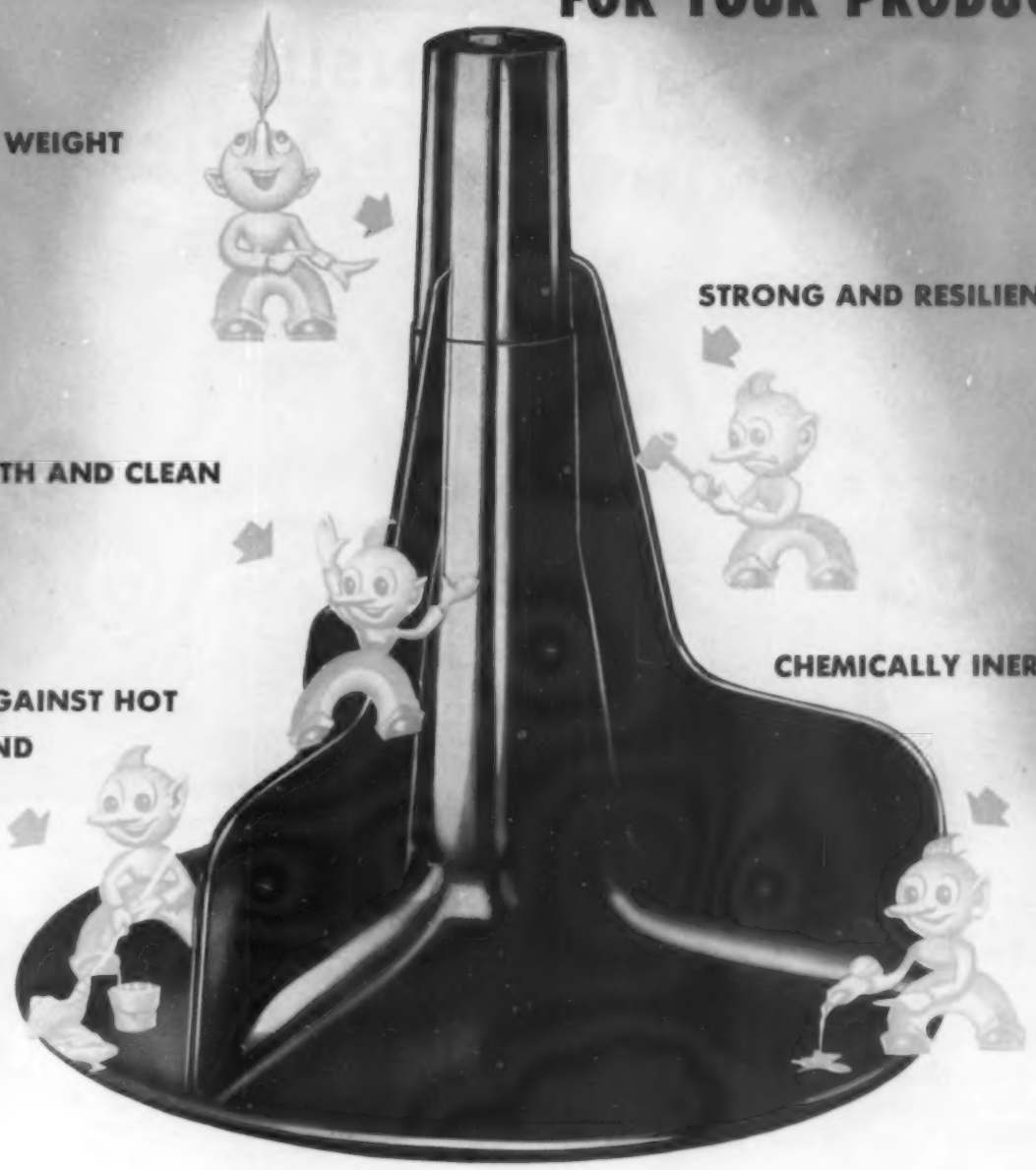

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MODERN PLASTICS

NOVEMBER 1945 VOLUME 23 NUMBER 3

The Plastics-Paint Racket

THOUGH frequently exposed by Better Business Bureaus in the last two years, the plastics paint racket continues to flourish. Companies have merged or disappeared, only to reappear under new names. Flamboyant advertising claims have been withdrawn under attack, only to be replaced by new products with the word "plastic" ingeniously embroidered into the trade name and the advertising. Capitalizing on the glamour and the war performance of plastics, unscrupulous promoters are selling ordinary house paints and finishes at large mark-ups.

Just how magnetic is the sales appeal of the word "plastic" these promoters appear to have been the first to recognize. As evidence of its appeal, a manufacturer of an old line of paints finds that his department store sales are falling off badly. About this time he is advised of the magic of the word "plastic." It happens that his company once had a trademark incorporating the name "plastic," and when it is reintroduced, sales of the identical paint multiply in six weeks, although the company indulges in no extravagant advertising claims or price gouging typical of plastic paint promotions. In such promotions the consumer has to pay at least double—and frequently more than double—the price of the same paint when it is labelled as ordinary paint.

Because of the premium prices and the claims of phenomenal performance of the "plastic" paints and varnishes, the National Paint, Varnish and Lacquer Association recently undertook a laboratory investigation comparing the "plastic" finishes with regular moderately priced shelf paints and varnishes. Their investigation was confined to consumer paints (i.e., the paints used by the consumer himself in his home) for it is in this field that the racket flourishes.

The investigation did not include the special product or industrial finishes which are sold by paint suppliers directly to manufacturers of stoves, washing machines and other products. In special product finishes the term "plastics paint" was occasionally used before the war, and is now being advertised for some postwar finishes not yet available. What actually constitutes a plastic paint or whether the term can properly be applied to *any* paint will be discussed later, but the chief purpose of the present discussion is to call attention to the deceit now being perpetrated in consumer paints under the name "plastic."

A report of the National Paint, Varnish and Lacquer Association[1] stated that none of the so-called "plastics finishes" on sale at that time had unusual properties. Most of them appeared to be no better, and many not as good, as ordinary paints which have been marketed for many years in the paint stores. Their finding was that none of the "plastic finishes" was entitled to be called "plastic" since no plastics were available for civilian paints or finishes.

Before the war a large volume of the synthetic resins, which

[1] Circular No. 701 (Jan. 1945).

are the raw materials of molded plastics, went into consumer paints and finishes, although they were not called "plastic." As pointed out in the Association report, which predates the ending of hostilities, "during the war the phenolics, alkyds and other synthetic resins have been under strict allocation and their use has been limited to military requirements and a few civilian uses of the highest degree of essentiality; they have not been, and are not, available for paint products of general consumption." The use of the word "plastic" in the "plastic finishes" now being ballyhooed is altogether unjustified; it is solely a means of capitalizing on the great amount of publicity concerning the performance of plastics during the four long years of war.

IT'S NEW—A MIRACLE LIQUID

Based perhaps on the glowing journalism describing plastic bomber noses and prefabricated plastic houses of the postwar, the public appears to have an almost mystical belief in the endurance of plastics. It is not strange, therefore, that supposed permanence of the "plastic finishes" is their principal feature. The earliest advertisements stressed the lifetime durability of the finishes. Though 20-year guarantees are less frequent now, it is still often claimed that a finish need only be washed every five years. Such propaganda has led some consumers to pay as much as $1200 for a house painting job that lasted only a few months.

"Plastic finishes" include what are actually standard paints, varnishes and enamels. Their advertising, however, emphasizes that the product is a *new* material, and to further this idea the word "finish" is generally used instead of "paint" or "varnish" (though some house paints are marketed under the label "plastic paint"). The householder is led to visualize something entirely different from ordinary paints and varnishes, something which has the surface of a molded plastic article instead of painted wood. This propaganda has been so thoroughgoing that even buyers in large department stores state with solemn conviction and an air of expounding science to the uninitiated that theirs is a *new* product which is in no sense a paint or a varnish. Just what category they imagine the finishes fall into is not quite clear, but they are convinced that they have a new discovery which has burst upon a war-starved public.

It is small wonder then that the ordinary consumer looks upon the finishes as a plastic miracle. One such householder complained to the Better Business Bureau that he had contracted to have his house finished with a plastic veneer for $600, but that actually ordinary paint was used which was of such poor quality that four complete coats were required to cover the surface.

Advertising and sales methods vary with the customer. For the department store clientele, advertisements hint at magical properties and attempt to associate the finishes with commonly recognized plastics materials. Claims are made of the resistance of these paints to every type of condition they could possibly be expected to encounter in use. For the carriage trade, a more refined note appears in the shoppers' columns of the slick magazines, noting that such and such a store has a mysterious new liquid floor finish that works like sheer magic, etc., etc.

For the householder who neither reads columns nor frequents department stores, the "show house" approach is clearly indicated. Salesmen solicit in neighborhoods of small one family houses, offering to paint the prospect's house for exhibition purposes at a reduced price since it is located in a new territory. In many such cases of misrepresentation, Better Business Bureaus have obtained adjustments. However, proof of liability is difficult since the advertising claims of performance, commissions, etc., are seldom written into the contract by companies.

The so-called "plastic finishes" vary considerably in quality, some being good quality house paints or varnishes while others are standard or poor quality. As many of the promoters of these paints do not manufacture their own products but buy them where they can and relabel them, the quality also varies from batch to batch. But all are sold at a considerable mark-up. Some stores have had laboratory or consumer tests made, comparing the "plastic finishes" with each other (though unfortunately not with ordinary paints and varnishes), and results have frequently shown the most expensive of these so called "plastic finishes" to be the poorest product.

The mark-up and labelling policy of the plastic paint promotions is revealing—dynamic labelling, it might be called. The Better Business Bureau of Detroit cites[2] one "plastic paint" operator who bought paint from a local paint manufacturer in quart cans. "The price charged by the manufacturer, in line with his OPA ceilings, was 70 cents. The cans were subsequently decorated with a plastics paint label and sold with no change in their contents to the public, including a Bureau shopper, at $2.95 a quart, plus 9 cents tax."

MODERN PAINTS ARE CUSTOM MADE

The synthetic resins which are the raw materials of the various plastics the public knows today, have actually been used in paints for many years. Nitrocellulose, base of the earliest of all the synthetic plastics, has been used in lacquers for more than 50 years and is still an important ingredient of automotive and furniture finishes. But though it is the same raw material that goes into pingpong balls and artificial leather, nitrocellulose paints were never called "plastic paints" before the war, nor was artificial leather called "plastic leather."

Similarly, the same type of phenolic resins that make molded parts for automobile ignitions have gone into enamels ever since 1922,[3] though the term "plastic paint" was never applied to these before the war. Their introduction improved the durability of automobile paints to such an extent that some automobile manufacturers went into an "all phenolic" protective coating and, still later, into an "all phenolic" base coating. In the future, such base coatings will be standard finishes.

Alkyd resins have been used in paints and varnishes since 1929,[3] and they furnished an important prewar ingredient of many special product finishes. Urea formaldehyde began to be used in special paints, such as paints for light reflectors, as early as 1936[3] while melamine formaldehyde made its appearance just before the war as an ingredient of special purpose paints. Any of these paints might, with some reason, have been termed "plastic paints" since they contained substantial amounts of the various plastic raw materials which are

[2] The Factfinder (Jan. 1945).
[3] Joseph J. Matiello.

notably lacking in the current spate of "plastic paints."

But the mere presence of small amounts of synthetic resin in a paint or finish does not necessarily justify the designation "plastic paint". Synthetic resins are but one of many raw materials that go into finishes—the chemistry of paint having become enormously complicated in the last few decades. In addition to synthetic resins, natural resins and many chemicals serve as raw materials.

In the trade, paints, varnishes and lacquers are strictly classified. The word paint is not ordinarily applied to special product paints, but only to paints developed for large surfaces, such as houses, barns or floors. In the paint category come all consumer sales and sales to stores by manufacturers—trade sales, as they are called. Trade sales, however, are only a part of the industry.

An important volume of business lies in the special product or industrial finishes sold to manufacturers of stoves, washing machines, locomotives, typewriters, baby carriages and thousands of other products, as well as finishes for industrial maintenance on machines and equipment. Each of the special product finishes is a custom-made or prescription finish for the development of which paint engineers go into the manufacturer's plant to study the requirements, the composition and the method by which the finish should be applied.

Different problems face the engineer in each product paint. Finishes for novelties and dime store toys need to supply only a cheap coverage, while a refrigerator finish must have exceptional endurance. Refrigerator and washing machine paints, though visually similar, are developed to resist entirely different conditions. A refrigerator paint need not withstand the alkali to which the paint of a washing machine is subjected, yet it must be able to withstand extreme moisture inside the box, as well as the chipping and the oils and fats to which the outside of the box is subjected. The paint engineer's choice of method of application, too, is strategic; great differences in economy would result, for instance, from a choice of spray or dip tank application.

WHAT IS A PLASTIC PAINT?

Opinions vary as to what constitutes a true "plastic paint." Years ago, before the advent of the plastic molding industry of today, the word "plastic" was applied to certain nonflowing wall paints similar to plaster. These were texture paints which could be applied with a trowel and actually be molded or formed in accordance with the original meaning of the word plastic. Ordinary paints cannot, of course, be molded; indeed, most of the "plastic paint" advertisements stress the fact that their paints level off, leaving no brush marks.

One school of thought in the paint industry holds that a plastic is something moldable, and hence that no paint is plastic except the texture paints. This idea is based on a belief that to the public at large plastic now means articles which have been molded (or cast or extruded) from synthetic resins—airplane noses, radio cabinets and the many gadgets and industrial parts made of plastics. The public associates the word plastic with such finished products and with their properties, they say, rather than with the synthetic resins which are their raw materials. In this view, then, there is no such thing as a "plastic paint."

This is also the point of view of a section of the plastics industry. George K. Scribner, president of the Boonton Molding Co. and past president of the S.P.I., makes the point that neither paints nor textiles nor any of the many other products now treated with synthetic resins should be called "plastic". Plastics, he says, are objects molded (or cast or extruded) into permanent form.

However, another school of thought in the paint industry takes an equally emphatic view that a paint may properly be called "plastic" if it contains a certain proportion of synthetic resin. As suggested by E. H. Bucy, president of the New York Paint, Varnish and Lacquer Assn., the definition might be: "any coating in which the preponderance of the soluble solids or binder contains more than 75 percent of one or more of the following raw materials: nitrocellulose, cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, ethyl cellulose, vinyl and vinylidene resins, acrylic resins, urea formaldehyde resins, melamine resins, allyl resins, phenolic, alkyd and polystyrene resins." (It should be noted that there are some resins, such as ester gums, which are classed as synthetics in the plastics industry but not in the paint industry.)

Though there is some support for the view that paints containing a percentage of synthetic resin could be classed as "plastic" (or, to put it more succinctly, should be allowed to cash in on the present sales appeal of plastics), there is, unfortunately no general agreement on what the percentage should be.

It is to be hoped that the Federal Trade Commission or the Bureau of Standards will, in time, establish a legal definition of a "plastic paint." The report of the National Paint Varnish and Lacquer Assn. suggests that "any conception of the word 'plastic' such as might be held by chemists and technicians, appears to be of less importance than the impression on the public mind which may be created by the use of the description 'plastic' applied to paints." Though technically there is much to support the definition of a "plastic paint" as a coating which contains a percentage of synthetic resins, it appears that, to the public, "plastic paints" are paints which have the character of molded plastics and will provide a hard, shell-like surface over wood, metal or other articles. Such paints are still in the laboratory stage, and will soon be developed now that the war is over. When they *do* appear, they will be a very far cry from the consumer shelf paints which are now being marketed under the name of "plastic."

It was stated long ago by the old Circuit Court that "the label is not intended to be dissected with the dictionary at hand"[4] and again by the Circuit Court of Appeals, that "Statute is intended to protect the ignorant, the unthinking and the credulous members of the public as well as the more sophisticated and intelligent."[5] Again, the Supreme Court stated, "Deception may result from statements not technically false or which may be literally true."[6]

The Federal Trade Commission is now investigating complaints about some of the "plastic paint" promotions to see whether action should be taken. If the Commission finds that the advertising of such paints is deceptive and misleading, or that their selling has been by fraud or deception, it can issue a "cease and desist" order requiring them to stop such unfair practices. Two lines of approach are open to the Commission in this investigation. The first is an approach based on the advertising, an inquiry to see whether the public has been misled by false claims, such as the durability, newness, etc., of the product. The second possible approach is to pass on the propriety of the word "plastic" as applied to

[4] Newton Tea & Spice Case v. U. S. 288F. 476,479.
[5] Charles of the Ritz Distributors Corp. v. Fed. Trade Com. (C.C.A.2). 143 F.(2) 676.
[6] U. S. v. Barrels Alleged Apple Cider Vinegar 265 U. S. 438.

paint. The Commission has the power to sample public opinion and rule on what the public understands by a certain word. *If* this should be their approach, and *if* they find that the word "plastic" is associated in the public mind with molded plastics and the properties of molded plastics, they could then prohibit the use of the word in such advertising. If the Commission does not rule on the word "plastic," the paint and plastics industries should themselves reach a definition, since deceptive advertising and unscrupulous promotion can only damage both industries. As reported in recent surveys in MODERN PLASTICS the plastics industry has worked unceasingly to eliminate unfair practices and to insure right applications of plastic materials.

PLASTIC FINISHES TESTED

In an effort to appraise the "plastic finishes," the Scientific Section of the National Paint, Varnish and Lacquer Assn. tested a number of them in their laboratories[1] comparing them with ordinary finishes for practical qualities such as hiding power (or the measure of its opacity, its ability to cover solidly over another color), gloss, ease of brushing, abrasion resistance, hardness (a much advertised feature), scrub resistance, resistance to chemicals, etc. The laboratory report showed that "none of the so-called plastic paints had unusual properties."

Finishes with three types of binders were tested—oil, resin and lacquer. The floor lacquers tested were not comparable to commercial floor lacquers found in the regular market. In paints and enamels also many of the regular finishes proved to be superior and very much cheaper. In exterior house paint a regular brand was compared with two brands of "plastic paint." In the words of the report: "They were found to be very similar in content of white pigment, character of pigments, oil binder and of volatile thinner. The cost per gallon of the ingredients in each paint was within a few pennies of the same figure. No unusual materials, such as phenolic resins, alkyds or other synthetic resins, were present in either paint. From the composition, it could fairly be stated that they would give equal service. One other brand of plastic house paint was found to be inferior in quality and much lower in cost of raw materials."

Regarding the length of life of these consumer "plastic paints," the verdict of several experts in the industry as to what constitutes a lasting paint is as follows: "A lasting paint job depends for the most part *on the condition of the surface to which it is applied;* the quality of the paint, that is, the formula; on weather conditions, and, of course, *on the ability of the applicators.* The mere omission or inclusion of any so-called plastic ingredient now available for consumer paints would have little or no bearing on the period of time the paint would serve as an adequate protective coating."

Because of the raw material scarcity which existed during the war, some present consumer paints are actually inferior in quality to prewar paints (though this does not apply equally to production finishes), and many of the old established paint suppliers market their paints under a label stating that the paint is a war product developed to save raw materials. One of the largest raw material suppliers states that as a generality, the present paints in performance go back to the first world war. Interior paints have suffered more than exterior paints, and some companies have discontinued their manufacture altogether on the ground that they are largely for esthetic purposes, while exterior paints are more essential for preventing rot.

Until such time as the term "plastic paint" is standardized, the consumer should follow a caveat emptor policy regarding paints with phenomenal advertising claims. Remembering that the quality and amount of all civilian goods suffered during wartime, he should realize that paints and varnishes were not exempt from the laws of wartime conditions and scarcities.

MODERN PLASTICS wishes to acknowledge the assistance of the National Paint, Varnish and Lacquer Association; E. I. du Pont de Nemours & Co., Inc.; Bakelite Corp.; Zapon Div., Atlas Powder Co.; and of Mr. George K. Scribner and Mr. E. H. Bucy.

WHETHER THE PLASTIC INDUSTRY IS aware of it or not, war veterans are expecting plastics to provide the materials that will make artificial limbs more efficient and comfortable than they have ever been in the past, according to American Legion national field secretaries, Charles McGonegal and Herman Pheffer.

Both of these men are veterans. One lost his forearms in World War I and the other lost both lower legs in World War II. They reported that great progress in artificial limbs is being made by the Army and Navy and deplored the criticism of the Armed Forces' program in prosthesis. They pointed out that for the last 300 years only wood, leather and rubber had been used, but present plastics developments may usher in a new era. They were careful to warn that sensational developments are not to be expected overnight. Furthermore, progress in jointed limbs will be slower than that for below the joint amputations.

Mr. McGonegal, who wears one arm of fiber and one of an impregnated cotton sock, which is supposed to be experimental but after months of use has shown no sign of wear, asserted that there are over 3,000,000 artificial limbs in the U. S. which cost an average of $250 each, and that nearly all of them needed replacement. Mr. McGonegal, who has received wide publicity because of his ability to use his hand hooks to light cigarettes, operate a typewriter, fasten buttons, pilot a plane, drive an automobile, swim, etc., has spent most of his time, since receiving his injuries, in aiding the cause of amputees.

One improvement he suggests is a moisture-proof coating for hand hooks. This is something the plastics industry might well supply. At present it is necessary for the amputee to use both hooks when lifting a liquid-filled tumbler, but it is believed that one hook would provide sufficient traction to hold a glass if the metal were coated with material impervious to moisture.

One advantage in the use of plastics is the speed with which a limb can be fitted. A wooden leg with a leather socket takes about six days to be adjusted. A leg with a plastic socket, according to Mr. Pfeffer, if it is not above the joint, can be made in one six-hour fitting and the reduction in time helps to keep the patient from becoming too uncomfortable and impatient—an important psychological asset.

COLOR PLATES AND PHOTOS, COURTESY THE HANDI CO.

A molded two-way clothespin

These colorful cellulose acetate clothespins are so constructed that they can be used like the traditional wooden pin or hung by a hook, which replaces the usual top knob, from either a clothesline, rod, wall bracket or hook

TRANSPORT a woman of your great grandmother's, or even your grandmother's, generation from the kitchen where she started housekeeping to the kitchen of today's bride and she would find few utensils that were familiar to her. She could spend hours fiddling with the knobs of the gleaming all-enclosed gas or electric stove without discovering its kinship with the great black coal stoves of her youth or with less unwieldy kerosene burners. The electric broilers, toasters, irons, the washing machines and mangles, would be equal sources of mystery.

Almost all household equipment has undergone a certain amount of redesigning in the last few generations. In some cases these changes have been carried to a point where today's products in no way resemble those of yesteryear. Again, as with measuring spoons, bowls and graters, there has been a refinement of design. But the housewife of the 19th century would never mistake these latter utensils for anything else but what they are.

A revolution in clothespins

Until a few years ago clothespins came within this last category. True, they had been smoothed down, even streamlined a bit. But grandmother would have pounced upon them at once, claiming them perhaps as her own. Even the newer spring type pin followed traditional construction, they were made of wood and were prong-like in design.

Then came the introduction of molded plastic clothespins. Tradition was thrown to the winds and along with it the long standing definition wherein clothespins are described as "a forked piece of wood or a small spring clamp used for fastening clothes on a line." Now a further drastic alteration has been made in these pins. The Handi Company has introduced a two-way molded plastic clothespin that can either be hooked or snapped on a line.

The development of this revolutionary plastic clothespin came about more or less by accident. The original intention of the company, when it contemplated starting operations soon after the outbreak of World War II, was to fill the gap left by the scarcity of wooden clothespins with a more durable pin. Every housewife knows the mortality rate of wooden pins. As a result of repeated wetting and drying these traditional pins lose their strength. Perhaps, if gently handled, they might continue in service over a longer period. But women give little thought to "handling with care" when they are struggling to anchor a bulky sheet or blanket to the line. A firm hard thrust down over the clothesline is the more

By virtue of their two-way construction these molded cellulose acetate clothespins can serve a multitude of uses. The prongs are designed with graduated openings so that the pin can accommodate clotheslines, wall hooks and hangers that vary widely in size and thickness

usual technique, and the splitting and chipping of the wooden pins the usual outcome.

Furthermore, these old fashioned pins leave something to be desired so far as flexibility is concerned. Try to snap them over an oversized clothesline and they are most likely to break through the middle. Another disadvantage of wooden pins is the way they blend in with the earth and grass when accidentally dropped as clothes are being hung to dry. Wet or dry, these pins are too close in color to the dirt to be easily retrieved.

The use of plastics in clothespins seemed the answer to all these problems. And so work was begun on a drawing for a plastic pin—but one of traditional design. It was only as the artist was worrying over the shaping of the top of the piece that the idea of a two-way clothespin began to crystallize. The usual knob seemed so useless. Why not supplant it with a more attractive shape? Why not with a design that had some practical use?

Women were always in need of skirt hangers, of a means of anchoring stockings left to dry in the bathroom, a way of airing dish rags and wash cloths. What could better serve these needs than a hooked clothespin? In the case of a skirt, two of these pins could be snapped on either end of the bar of a man's coat hanger, the hooks hanging downward. With two such stationary supports it would be a simple matter to slip the loops at the waistband over the hooks. And as for drying clothes in the bathroom, either the hook or the pronged end of the pin could be slipped over the towel rack or clothes hook. Wash cloths and dish rags, on the other hand, could be secured in the conventional end of the pin and the hook hung over the wall bracket.

While having, perhaps, more unexpected uses inside the home, these molded plastic pins are equally well suited for outdoor use. Repeated soakings in water, day-long exposure to the sun, leave them unaffected. Tests have indicated that they are 10 times stronger than wooden pins although the two are comparable in price. Best of all, they can be washed free of dirt in the twinkling of an eye. This is in contrast to the scrubbings that must be given wooden pins when they accidentally fall to the ground. Another advantage of these pins is their small size.

The new design has also opened wider fields of application in places other than the home. Newsdealers need no longer string special hangers for the display of current periodicals. Using these molded two-way pins they need only string a wire or cord across the front of their stands. The pronged sides of the pins will serve to grip the magazines while the hooks loop over the supporting cord. Reversing positions, some merchandise can be dangled from the hook while the prongs are secured to the display wire or rod.

From design to production

No matter how good an idea may be, weeks and months of trial and revision are necessary before it is ready for public display. So it was with the two-way clothespin. After the original sketches were completed, they were submitted to a firm of designers and engineers. From this work evolved a sample plastic pin. As a double check, this sample was turned over to an executive of a national chain organization. More tests were made. The results were so encouraging that this executive placed an order for a large quantity of the pins even as he reported on his findings.

One further change in design was found necessary before work was begun on the production molds. To keep the parting line from being on the inside of the pin, the original pattern was modified slightly to conform to the construction of the pins shown above. It was felt that there was a chance of clothes being damaged by surface irregularities should the parting line be on the inside of the prongs of the clothespin. After a sample pin of this new design had been made, tested and approved, the mold maker was free to start work, first on a 14-cavity mold and then on one with 24 cavities.

Upon completion, the finished mold was delivered to the Claremould Plastics Co. Almost every type of plastic was tested for use in these Handi-Pins. Samples molded of each of these materials were tested for heat, cold, strain, flexibility, cold forming and various other qualities. Lumarith of a hard flow was the plastic finally selected for these pins.

Mass production got underway immediately at both the Claremould Plastics Co. and The Emeloid Co. The 14-cavity injection mold operates on a 22 sec. cycle while the 24-cavity die has a 29 sec. cycle.

The first runs of these two-way clothespins were limited to a few basic colors, but, as material has become more available, additional colors have been added. The 4-color illustration on the first page of this article shows the range of shades in which the pins will be appearing on the chain store and department store counters.

These colors, by the way, have been found to have a practical as well as an esthetic value. The unsightliness of clothes hung to dry in the bathroom or kitchen is somewhat mitigated when the drab ungainliness of wooden pins is eliminated from the scene. In fact, the bright colored plastic pins have a decorative effect. Out of doors, the vivid colors make the clothespins easy to find when they are dropped or when their basket is upset.

To take full advantage of these colors as far as merchandising was concerned, the company ruled out the use of mounting cards or packages. It was felt that either type of display would detract from the appeal of the colorful pins themselves. A loose trayful of clothespins of many colors was deemed a better selling force.

These molded plastic two-way pins were originally sold from the counters of a long line of chain stores. The idea was to get as wide a mass distribution as possible in the shortest possible time. Wooden pins were in short supply at the time and there was the opportunity to establish a firm place in the market with a minimum of sales effort.

PRECISION . . . in a wrist compass

Three precision molded plastic parts go into the assembly of this wrist compass. The instrument housing, the indicating dial and transparent window are grouped in the center of the accompanying illustration. A white line painted on the clear dome-shaped window facilitates the reading of the liquid-type precision compass

THERE were days when youths were satisfied with approximations of the real thing. And times when such things as inexpensive compasses were marketable even if they were somewhat erratic. But now, precision seems to be the criterion in all types of merchandise. This may be the result of present-day emphasis on scientific studies or of wartime experience when accuracy in mechanical equipment was all important. Whatever the cause, this insistance on precision is making itself felt in all types of articles, even to the wrist compass that sells for just under two dollars.

An inexpensive wrist compass

Such a compass has been developed by DuPage Plastics Co. based on the design of the dial-type liquid compasses this company produced for the Army Air Corps during the war.[1] Weighing approximately one oz., this instrument consists of three Tenite II or Lumarith parts—the case, dial and window.

Available with either a red, a white or a black case the compass is being featured by Harold S. Schwartz and Associates, sole merchandisers of this unit, as an ideal gift for Boy and Girl Scouts, and for hunters, campers and sailing enthusiasts. Sales emphasis is upon the luminous dial and the fact that the compass requires no adjustment for a true reading.

Directions for using the instrument are of the simplest. The phrase "you are looking" is stamped on the edge of each plastic base just underneath the white line that extends halfway across the transparent dial. To find his directions the user of this wrist compass need only face this white line while holding the instrument in a perfectly level position so that the directional dial revolves easily within the liquid case. In almost no time the dial will stop. The direction in which the wearer is facing will appear at the point of the white line.

Molding the three compass parts

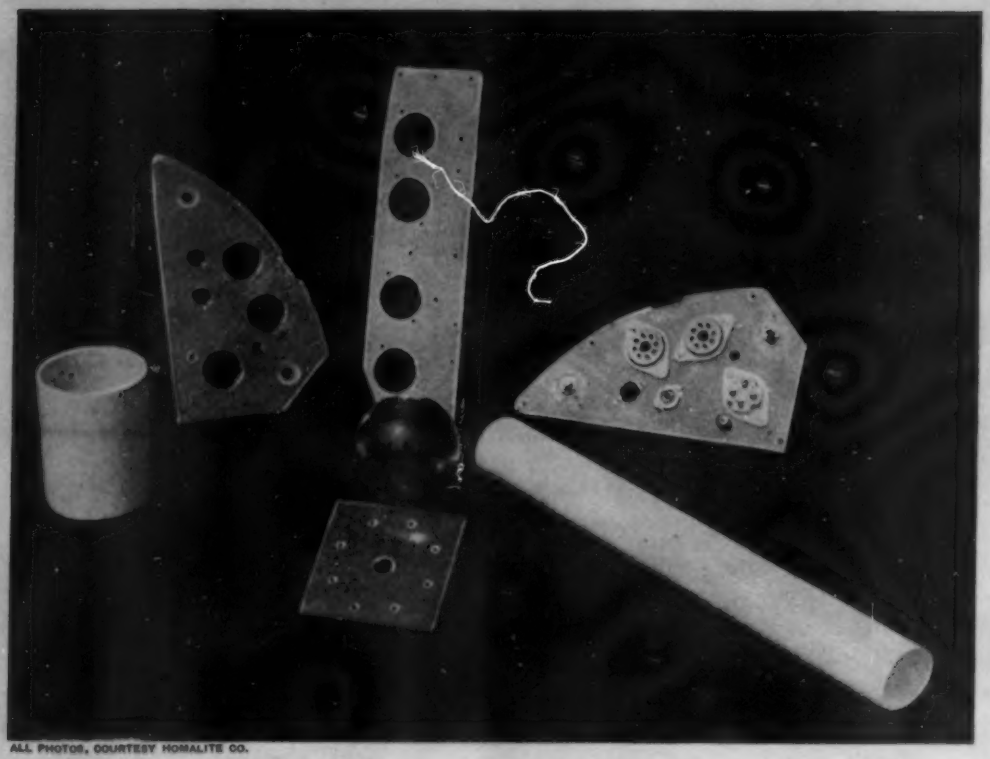
Each of the three cellulose acetate or cellulose acetate butyrate parts in this compass is molded in a separate 6-cavity die. Thus, there is one die for the base, one for the card or dial and one for the transparent window. Tolerances are extremely close on all these parts—between $^{1}/_{1000}$ or $^{2}/_{1000}$ inch.

According to DuPage Plastics Co., which also does all the molding and the assembly work on the instrument, these tolerances are necessary for several reasons. Since the base, the dial and the window are cemented together in assembly, they must be of an exact size to insure a firm bond. Aside from the obvious danger of one or the other of the parts becoming detached should the cemented joint be poor, there is the compass liquid to be considered. The smallest crack between the base and the window will release the liquid and render the compass useless.

To achieve the required tolerances this company employs a very slow molding cycle to assure the parts being molded with as little strain as possible. Then, after the pieces are removed from the die they are seasoned for at least 48 hours. This seasoning is repeated after assembly and cementing.

It might be said that this wrist compass is a product of war. Only by utilizing the skill and techniques developed during the war has this company been able to turn out such a precision compass at such a low price.

[1] "A foolproof and practical compass," MODERN PLASTICS *22*, 124 (June 1945).



ALL PHOTOS, COURTESY HOMALITE CO.

1—Panel boards and other parts for electronic and radar equipment, cast of unsaturated polyester resin, are high in arc resistance and in dielectric strength

Casting of unsaturated polyester resins

The characteristics of unsaturated polyesters, relatively new materials of the last two or three years, are described in the Army-Navy specification, JAN-P-77 as follows: "This type of material is a tough, solid cast resin, having good optical, electrical and mechanical properties. It possesses good machinability, and excellent abrasion resistance. It requires a long curing time beginning at relatively low temperature. The addition of powdered or fibrous fillers may be used to reduce shrinkage. Variations in the resin itself can be used to obtain greater color and increase hardness, though at some slight expense to the other properties. This type of material has a very high heat resistance. It may be used for the optical study of stress distribution in models."

UNSATURATED polyester resins show promise of wide application in electrical equipment—particularly in radio and radar. They offer interesting possibilities, too, in the decorative field because of their good color, their natural luster and transparency, and their resistance to aging.

The material is durable, very hard, and has greater scratch resistance and dimensional stability than similar resins in the thermoplastic field. It has an excellent color range similar to that of methyl methacrylate, but it lacks the water whiteness of the methacrylate resins, its basic tone being clear amber. It has low cold flow and therefore does not bend under weight like a thermoplastic casting.

Cast sheets withstand tremendous thermal shock without cracking or failing. In a recent test, a rigid sheet was heated in an oven to 300° F. and then doused in a container of acetone and dry ice (temperature approximately -80° F.). The sheet was unaffected by the test, and even when heated again showed no cracks or strains. The material is moisture resistant, and accelerated and actual weathering tests attest to its durability. It is unaffected by solvents such as aromatics and alcohols, and has good resistance to acids and alkalis.

One of the first plants in the country to cast Laminac, Selectron and Paraplex was the Homalite Company. Beginning in March 1945, the company is now producing cast rigid sheets, reinforced glass cloth panels, rods and tubes in pilot plant quantities. It is also experimenting with flexible sheets.

Sheet casting

Preparation of the plate glass mold—The casting of these resins requires great care and precision in the preparation of the molds as well as of the resin. For castings up to 3 ft. square, $1/4$-in. tempered and polished plate glass should be used. The surface of the glass must be very thoroughly cleaned and dried. It may or may not be lubricated.

The mold is made by laying rubber tubing in a U shape on one sheet of glass about 2 in. in from the edge. Any kind of rubber tubing can be used, but some of the synthetic rubbers leave a yellow line on the edge of the casting which must be trimmed. Tubing of a thicker dimension than the desired casting is used, a $3/4$-in. tube being used for a $1/2$-in. casting.

A second sheet of plate glass is laid on top of the tubing, and the two sheets are clamped together with C clamps. For small sheets, the resin is poured into the glass mold either horizontally or vertically, depending on the size and shape of the casting. But in large sheets, care must be taken to maintain the thickness tolerances and the mold is tilted and supported at an angle of 45 degrees with the open end up.

Preparation of the resin—The material is cast from the original monomer, which is mixed with catalysts and accelerators in a tank equipped with a high-speed stirrer. Catalysts

used are organic peroxides, such as benzoyl or lauryl. They are used in quantities of 1 percent or less—about one half of 1 percent for the resin in the cast sheets.

After the accelerator is added, the stirring is stopped to allow trapped air to come to the surface. As in most resin casting, air bubbles are a problem and it is important to allow them to escape.

No heat is used, and the accelerator is added immediately before pouring, since the resin gels in about one hour (at normal temperatures) after adding the accelerator. The casting itself generates intense heat, particularly after it reaches the gel stage.

Curing—The resin is poured carefully into the glass molds to avoid trapping air. The molds are then heated for 2 or 3 hr. (depending on the size of the casting) at 140 to 160° F. This changes the resin from a liquid to a semi-hard casting. (An alternate procedure is to allow the resin to stand in the molds overnight at room temperature to reach the gel stage. This procedure is slow for commercial work.)

The semi-hard casting is removed from the oven, clamps and rubber gaskets taken from the mold. The casting while still between the glass sheets is baked for half an hour or more at 220 to 300° F. to temper the casting and remove any possible strains. The casting becomes very hard and rigid after it has been at 300° F. for a short time.

The glass is pried off while the casting is still too hot to handle since the resin sticks when cool. The resin as it shrinks and cools exerts great strength and frequently pulls large chunks out of the glass mold. Lubricants, such as paraffin wax, keep the resin from sticking to the mold, but they cause lines on the surface and for that reason are seldom used.

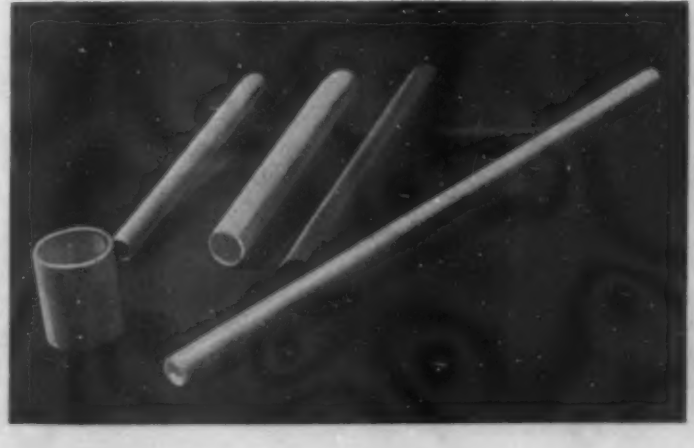
The resin can also be cured at room temperature if more accelerator is used. However, too much accelerator, like too rapid heating, cracks the casting because of the intense exothermic reaction of the resin itself.

Glass cloth panels and flexible sheets—Rigid sheets reinforced with glass cloth (using either staple fiber or continuous filament glass cloth) are also being produced by this company. The glass cloth gives greater impact strength and stiffness at temperatures above 200° F. along with the properties already noted in this resin—light weight, low moisture absorption, low cold flow, good dimensional stability, arc resistance and dielectric strength.

Flexible sheets are also being cast, using a modified resin. They will have a future as gasket material and wire covering.

2—*Highly polished tubes and rods are cast of polyester resin in a variety of diameters and wall thicknesses, in lengths up to 4 feet.* **3**—*A special polyester resin window for a high-low temperature testing chamber*

2



Rod casting

Rods are made by casting these resins into hollow glass tubes which are cured and baked in the same way as sheets. Such rods may be used for insulators for winding coils.

Tube casting

Casting of tubes has passed the experimental stage. Made by a slush molding technique, the tubes have a highly polished surface, and can be made in a wide range of wall thicknesses with close tolerances. They are made without a taper. Standard lengths are 20 in., but 46-in. tubes are feasible.

Problems and prospects

Problems in the casting of the resin are shrinkage which runs from 7 to 12 percent, and the fact that thick sections require a long curing time. The exothermic reaction, too, must be carefully watched, as the castings crack with too much accelerator or too rapid heating.

Sheets of the material are a definite contribution to the fabricator in that they are offered in larger sizes than heretofore available in cast thermosetting resins. Rods and tubes cover a wider range in diameter and length, and are supplied with a highly polished surface without a taper.

Standard sheet sizes for transparent, translucent or opaque colors are 18 by 32 inches. Larger sizes are made on special order. Thickness of sheets offered are $1/16$, $1/8$, $3/16$, $1/4$ and $1/2$ inch. Sheets thicker than 1 in. can be produced if required.

The standard length for rods is 20 in. but, as in the case of tubes, 46-in. lengths can be made. Rods are available in the same variety of primary colors, ivory and black as the sheets. Diameters cover this range: $1/8$, $1/4$, $3/8$, $1/2$ and 1 inch.

3

Instruments for the diagnostician

THE medical profession is one of the most demanding—of its equipment as well as of its men. For the most part the instruments are complex in shape, yet they must meet the most severe dimensional requirements. Surfaces must be smooth and of high luster while maintaining a warmth that is pleasant to the touch. And, most important of all, the parts must be capable of withstanding sterilization in either boiling water or in cold sterilizing solutions without any loss of strength or finish.

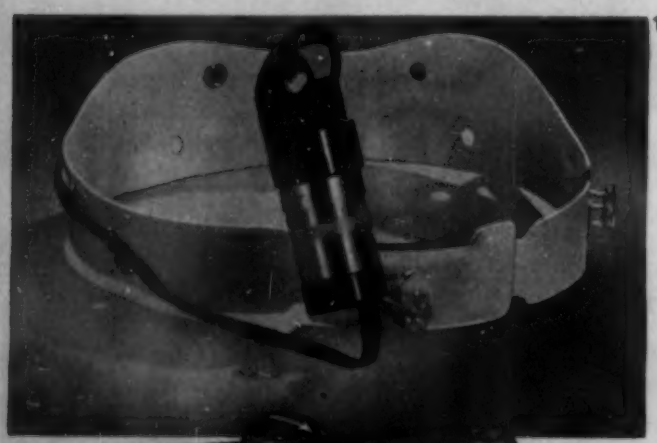
For the past 13 years the National Electric Instrument Co., Inc., has met these exacting conditions in their line of diagnostic equipment for physicians and surgeons through the judicious use of plastics. However, when the company first considered incorporating plastics in its instruments, difficulty was experience in finding a plastic which was unaffected by sterilization. Finally, through the cooperation of the chemists of Watertown Mfg. Co., molders of the plastic parts of this medical equipment, a special formulation of the phenolic molding powder Neillite was worked out.

This phenolic compound was found to meet all conditions that are set up for diagnostic instruments. Not only is this material amenable to sterilization in either boiling water or in cold sterilization processes but it has only one-third the moisture absorption of general purpose phenolics. Even after continued immersion in boiling water, parts molded from this formulation retain their high impact strength.

According to Walter Arnesen, president of this medical instrument company, the way in which plastics can be processed into intricate shapes makes them particularly suitable for use in diagnostic equipment. However, he stresses that some thought and research must be devoted to the selection of the right basic materials and their application to the parts for which they are best suited.

Specialists headlight

This practice of carefully selecting a material on the basis of the use to which it is to be put is well exemplified in the specialists "center-of-beam" headlight pictured in Fig. 1. Three materials—cellulose acetate butyrate, ethyl cellulose and the specially formulated phenolic compound—are com-



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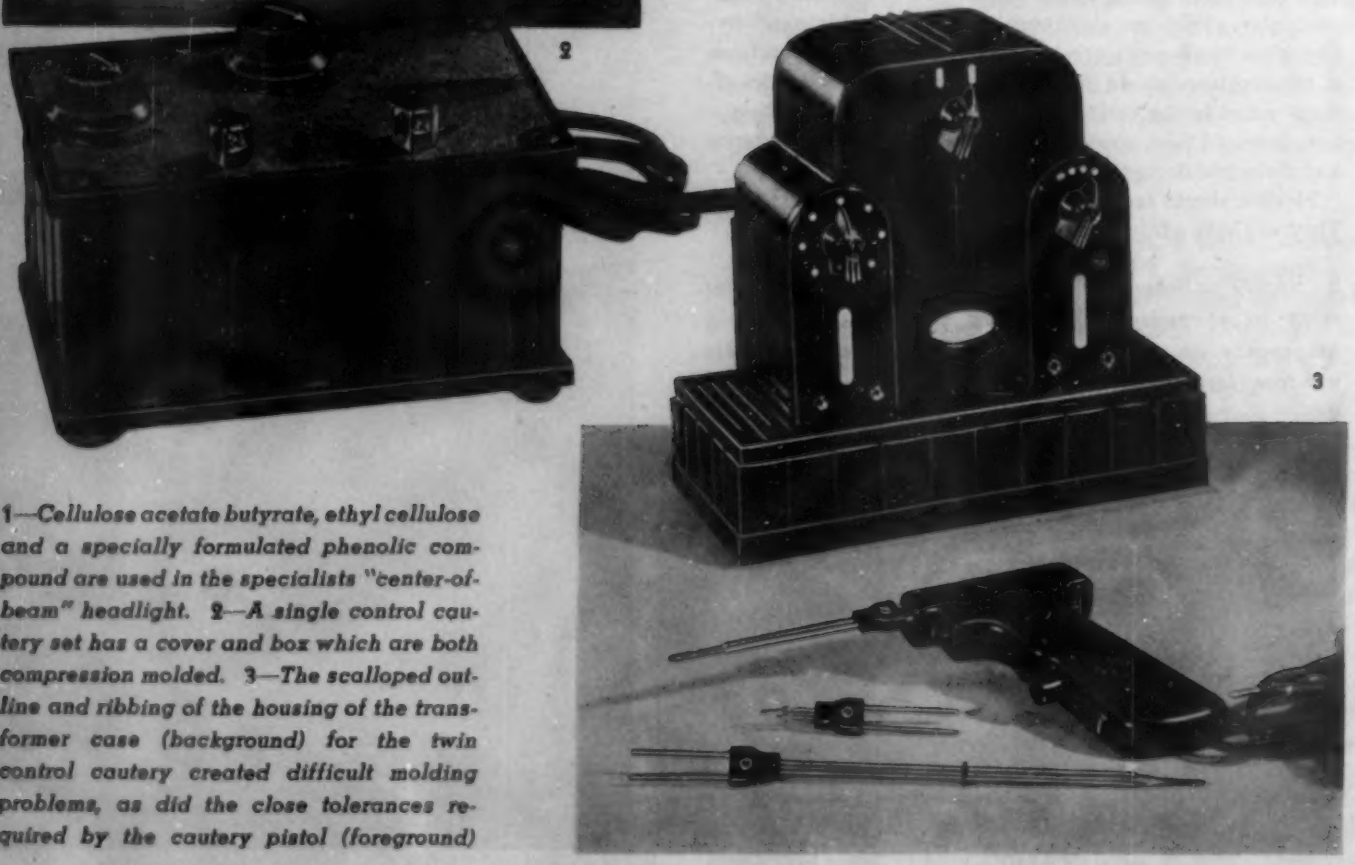

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1—Cellulose acetate butyrate, ethyl cellulose and a specially formulated phenolic compound are used in the specialists "center-of-beam" headlight. 2—A single control cautery set has a cover and box which are both compression molded. 3—The scalloped outline and ribbing of the housing of the transformer case (background) for the twin control cautery created difficult molding problems, as did the close tolerances required by the cautery pistol (foreground)

bined in this one instrument. Each is used for the part where tests have indicated that it best fits the conditions to which that part is subjected. For instance, the headband is stamped from sheets of ethyl cellulose because it is semi-flexible, perspiration-proof, light and washable. This band is the only plastic piece not turned out by Watertown Mfg. Co.

Cautery sets

Equipment for both a single control cautery and a twin control cautery set is shown in Figs. 2 and 3. Both the cover and the box of the single cautery are compression molded of the phenolic compound this manufacturer uses in all its instruments in single cavity molds. Four studs are molded into each of the covers to accommodate the dials.

The housing of the transformer case of the simplified control cautery (shown in the background of Fig. 3) presented a number of difficult molding problems because of the scalloped outline and the ribbing. Originally, this case was molded upside down. However, porosity was encountered at the bottom of the wall when this method was followed and the molding company decided to reverse the die. This change eliminated porosity, simplified molding, and doubled production output.

This housing contains four large metal studs that are molded into the front surface. Extra space for storing tips and extra bulbs is provided by grooved shelves on the sides.

Like the transformer case, the cautery pistol (foreground of Fig. 3) is molded of Neillite. If this instrument is to function properly, the halves must be absolutely uniform, and they must be straight. To achieve this goal, the molders employ shrink blocks and chill both halves of the combination mold. In this manner they have overcome all danger of distortion and shrinkage. The separators which prevent shorting between cautery tips are also molded of the special phenolic compound.

Otoscope and Retinoscope sets

The heads of both the otoscope and retinoscope sets are good examples of the complicated contours often demanded of diagnostical equipment parts. Here, as in the headlight set, conditions of use demanded that different materials be used in the two parts. Thus, while the top of the retinoscope is injection molded of Tenite II in a 4-cavity cut-off mold, the head of the otoscope is compression molded of Neillite.

The battery handles for the two instruments are identical, however. Available in two sizes, this base is injection molded of Tenite II. It consists of a cap and a case, both of which are turned out in one combination mold.

Ear specula set

These ear specula, which are made in four sizes, must be boilable, impact-resistant and non-reflecting. The first two of these qualifications are achieved through the use of the special phenolic formulation; individual treatment inside the tips does the third. Each of these tips is molded in a 6-cavity combination mold. They are available either in sets of 12, mounted in a special recessed case or in sets of 4, fitted one within the other and housed in a case that matched the tips in shape.

4

5

6

Instrument parts may have complex contours as in heads of (4)—the otoscope and (5)—the retinoscope. The top of this first unit is compression molded of a special phenolic compound, the second injection molded of cellulose acetate butyrate. 6—Ear specula must be boilable, impact-resistant, and non-reflecting

A PLASTIC "FACETED-SHAPED DIAMOND" injection molded right through a cloth provides a new medium for the handbag manufacturer. Tiny cubes of cellulose acetate are permanently welded to cloth by a special molding technique developed and patented by Plastocraft Co. The cellulose acetate is forced through the cloth into a mold which creates the desired pattern of plastic cubes. Finished mats, measuring approximately 9½ by 15 in., are cut, sewn and shaped into handbags.

The lustrous plastic surface is color fast, won't fade or tarnish, and is easily cleaned with a damp cloth. The individual plastic beads are integral parts of the fabric backing, won't chip or drop off and are sufficiently close together so that dirt can't gather between them. Moreover, there is no lacing between the cubes to soil or break. Bags made from this material are flexible, light in weight, and capable of standing rough handling.

The three models pictured at left—bandbox, drawstring pouch and the perennial zipper-topped envelope—show what can be done with this plastic-fabric material. The pouch and envelope use two large mats for the front and back and two small strips for side gussets. The bandbox combines the same pieces into a continuous strip of this unusual material.

The handbags up to the present have been produced in white, black, brown and red in the faceted-shaped diamond pattern. Pastel colors and varied designs are planned for spring and summer lines.

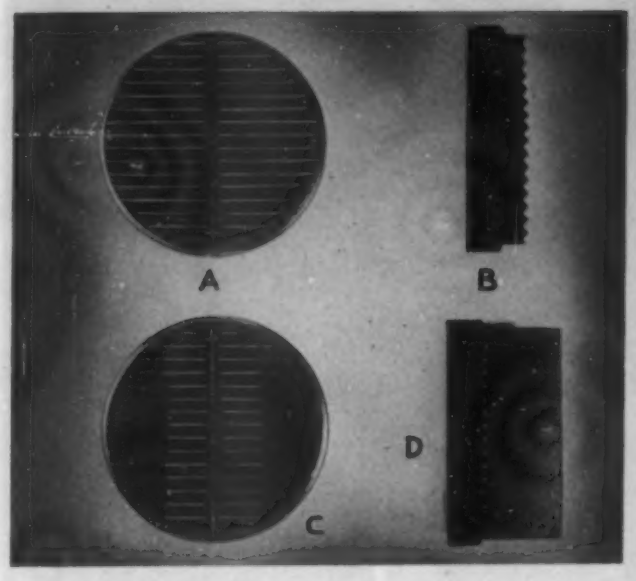
TRUE CROSS-SECTIONS OF SMALL WIRES FOR microscopic study and measurement can be obtained by an ingenious method devised by the Schenectady Works Laboratory of General Electric Company. Wires of such minute diameter that they cannot be severed by ordinary means without being badly smashed can, when embedded in a block of plastic, be cut through without distortion. Either Textolite, Lucite or Selectron is used for the block.

In forming a Textolite or Lucite block, a small amount of plastic powder is poured into a mold which has been corrugated with grooves with 45° angles and measuring 1/32 in. across the widest section (A and B). The slug thus formed is not entirely cured since the powder which is added later to form the top half of the block will not adhere to a hard surface. Short lengths of the wires to be measured are placed in the grooves (C) and covered with a small amount of extra fine molding powder. The mold is then filled to proper level with powder of average coarseness and the curing completed. The fine powder is used because it can work around the wires and hold them firmly. D shows the finished mold after cutting perpendicular to axis of the wires. Twenty-four wires from 1/32 in. to the smallest wires made may be molded at one time. A stock of these slugs can be kept on hand in order to speed up the molding process. Once the block is sawed in half and the surface polished the specimens are ready for examination with a microscope. This method has proved such a success that the laboratory is having a square mold of this type made to facilitate cutting at right angles to axis of wire.

PLASTICS

GOOD NEWS FOR FISHERMEN IS A VARIABLE buoyancy fishing float which will hold a 7-in. chub minnow to a set depth when one is fishing for muskies or can be used with smaller minnows for bass fishing.

Of the five parts which go to make up the float, three are of plastics. They are the buoyancy chamber, the locking plunger and the housing. The cylindrical Chinese red buoyancy chamber is produced from Lusteroid by Lusteroid Container Corp. The locking plunger (the second plastic part) is injection molded of transparent Tenite in a 12-cavity mold. The housing is also injection molded but of green Tenite in a 10-cavity mold. The two non-plastic parts that go into this float are the cork seal and the locking



The method of casting Selectron slugs, used with copper-silver filaments found too fine to withstand the heat and pressure of the molding operation, closely resembles that used for the other blocks. The difference is that the corrugations are in the bottom of the mold and the liquid resin is poured into a rectangular shell. After setting, the slug is turned over, the wires laid in the grooves and more resin added. This hardens into a solid mass and the mold is cut preparatory to the examination of the filaments.

PRODUCTS*

spring which is formed of music wire that is plated with cadmium. The Chapman Float Co., designers and producers of the buoyancy float, adopted plastics for three reasons. It was felt that the bright red of the buoyancy chamber and the green of the housing would have a high sales appeal. At the same time the Chinese red would permit long range visibility on rough water and when the sky is overcast, with the green transparent housing offering low visibility to the fish and allowing the fisherman to see the position of the locking plunger. The use of plastics assures lasting colors.

When the cork seal is removed allowing water to enter, the buoyancy of the float is reduced, sensitizing it to the action of small fish. If the full 2 oz. buoyancy of the float were maintained while using small light bait, the float would stand so high in the water that it would flop over on its side and be difficult to see. On the other hand a heavy bait would pull the float beneath the water unless it were nearly filled with air. When the locking plunger is in position, the float will ride down the line to the leader but not in the other direction and the fish can be reeled in right up to the rod end without interference.

A change-over from still fishing to casting can be easily made as it is possible to remove the float without breaking the line. The locking plunger can be pushed up and set on ledge, creating an opening through which to pull the line with leader attached.

* Reg. U. S. Pat. Office.

STARS IN THE MAN-MADE HEAVENS HIGH above the main concourse of Grand Central Terminal owe their unusual clarity and accurate degree of brilliance to light-piping Lucite rods recently installed in the new rockboard ceiling. The mural, which is said to be the largest in the world, displays a vast panorama of the winter sky. Represented in the mural are constellations seen during those six months of the year, along with their corresponding signs of the zodiac, Aquarius in October to Cancer in March.

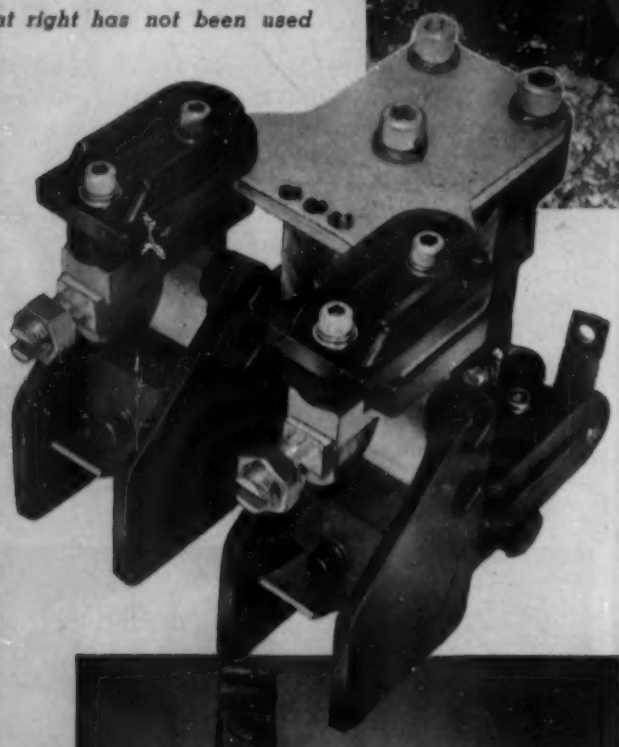
Sixty of the brighter stars in the mural depend for their brilliance upon pieces of transparent methyl methacrylate which are fabricated to a shape somewhat resembling enlarged golf tees. These $2\frac{1}{2}$-in. plastic rods, each of which is suspended directly below a 10-watt bulb so that its tip extends just below the surface of the ceiling, emit a pleasantly soft glow that can be seen from any part of the station floor.

As star gazers with even a smattering of scientific knowledge are aware, the stars are classified according to their brilliance into various magnitudes, those of the lowest magnitude being the brightest. Stars dimmer than the sixth magnitude are not visible to the naked eye. A celestial range of from $\frac{1}{2}$ to the fifth magnitude is obtained in the stars shown on the ceiling of the Grand Central Terminal through the use of rods with diameters ranging from $\frac{1}{2}$ to $\frac{1}{8}$ inch.

The innovation of plastic "light-piping" in the 32-year-old mural, it is said, has been greeted with considerable enthusiasm by scientists at the Hayden Planetarium. And the crowds of people who visit Grand Central Station evidence their interest daily in the new ceiling by a star gazing act.

1—Mining machinery is subjected to heavy duty. 2—All insulating parts, including arc barriers, on this double pole control contactor are made from rag-filled melamine. 3—High arc resistance of melamine molding material is illustrated by the control part shown on the left. Although its metal parts fused, the plastic insulations were scarcely affected because of short circuit between main line contractors. Part shown at right has not been used

ALL PHOTOS, COURTESY OF AMERICAN CYANIMID CO. 1



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3

Melamine in the mines

by PRESCOTT C. FULLER*

FIFTY years ago, mining operations were a slow, laborious process. It was necessary for each ton of material to be taken from the earth by the pick and shovel of a sweating laborer. The hazards incident to this occupation were many.

Basic conditions are still the same, but the miner of today is protected by the fruit of scientific and mechanical advancements. Giant machines now do the cutting, loading and carrying of the ore. The modern miner has become primarily a machine operator. Continual improvement of mining equipment has materially reduced the hazards and is making an important contribution to increased operational efficiency.

There are still many problems and dangers, but they are specific rather than general. For example, ever since electrically driven machines were introduced to mining operations, there has been a problem involving proper insulation. The presence of dirt and moisture on insulating surfaces tends to create a path which will act as a conductor for an electrical current. Many insulating materials in the presence of an electric arc across their surface will char, thus creating a permanent short circuit. Such short circuits on electrical controllers have meant certain delay and the possibility of fire.

The Joy Manufacturing Co., manufacturer of mining machinery, felt that an additional safety factor could be introduced which would offset this difficulty. The equipment produced by this company includes a variety of rugged conveyors, loaders and shuttle cars.

Melamine-formaldehyde insulation

About a year ago, dissatisfaction with insulating mediums then in use on electrical controllers caused this equipment company to look for a better material. Excellent electrical

* American Cyanimid Co.

properties—particularly arc resistance—were required, combined with sufficient strength and impact resistance to withstand the shock and vibration suffered by this equipment.

Experimental moldings were made from Melmac, a rag-filled melamine-formaldehyde molding material. Parts manufactured from this compound were put under test and found to combine high impact strength with the required arc resistance. The company decided to adopt this material on their electrical controllers wherever possible.

Now, 29 different molded parts have been incorporated in their machines. And, when the program of replacement is completed, controls will be equipped throughout with this melamine-formaldehyde insulation.

High arc resistance a necessity

These mining machines are electrically driven and control equipment is placed in explosion-proof housings for protection against the dust and dampness ever-present in the mines. Arcing, caused by heavy-duty, direct-current service, releases energy which causes the oxygen in these sealed housings to combine with nitrogen, thus forming nitric oxides. Electrical equipment must be inspected and cleaned periodically. But when the housings are opened, the nitric oxide absorbs moisture and nitric acid, a conductor of electricity, is created. This introduces two new factors. First, the acid attacks all surfaces on which it is present. Second, the range of any spark is greatly increased and many materials will carbonize, thus ruining the insulation and causing electrical breakdown.

Melamine resins, regardless of the filler used, show extremely high arc resistance. They do not support combustion and will not easily break down and carbonize in the presence of an intermittent arc. The normal action of the arc is inhibited by this material. Laboratory studies of rag-filled melamine moldings show that such moldings will allow instantaneous arcing in the presence of nitric acid on their surface, but the heat of the arc thus created dries up the acid almost immediately with no carbonizing of the plastic surface. The acid itself has no effect and, after drying, normal arc resistance of the material is again obtained.

Many insulating compounds exposed to these same conditions will rapidly acquire a coating of some nitrate which acts as an electrolyte. Although the heat of an arc will drive off the water that is present, the nitrate crystals will remain. With the introduction of additional moisture, the surface of the insulation will again become a conductor. The surface will soon char and no longer be an insulator.

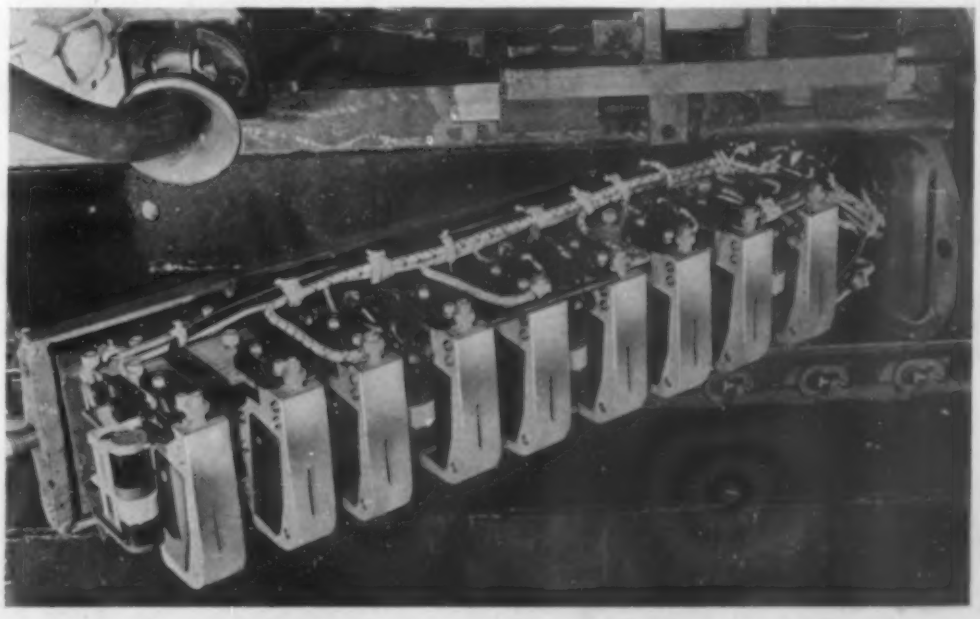
Studies have shown that rag-filled melamine-formaldehyde receives no deposit of nitrate even when exposed to arcing in the presence of moisture over a long period of time. This is attributable to the fact that there is no chemical compound present in the material which will combine with the nitric acid. The 111-sec. arc resistance of the material used by the Joy Manufacturing Co., is extremely high for any plastic material. Combined with the plastic's property of resisting a nitrate deposit, this arc resistance makes the compound ideal for use in mining equipment.

A classic example of the arc resistance offered by this molding material is a control part which broke down because of a short circuit between main line contactors. The metal portions of this unit fused as a result of the intense heat engendered by this short. The plastic insulation was scarcely effected. Because of its high arc resistance, the plastic reduced the possibility of this arc passing on to other parts of the unit and destroying them.

Parts must withstand rough treatment

The life of mining equipment is relatively short because of the severe operating conditions which are encountered. For instance, a shuttle car transports 4 tons of coal from the face of the mine to the mine car or belt conveyor over tortuous and bumpy road beds. All equipment, including the electrical controllers used on these cars, must withstand the same rough treatment. A broken part causes just as much trouble as one which has permitted tracking of an electrical arc across its surface.

However, because of this rough treatment, insulating parts are quite likely to break unless they possess superior physical properties. Rag-filled melamine is designed for industrial application where resistance to shock is desired of the finished product. This material combines a relatively high izod impact strength of 0.686 with the extremely high flexural strength of 14,000 p.s.i. These properties materially reduce breakage due to shock and vibration, regardless of the application. Since the use of melamine-formaldehyde insulation parts in this mining equipment, there have been extremely few failures.



4—Electrical control panel, mounted on shuttle car, is removable for inspection. Many of the insulated parts of this panel are molded from rag-filled melamine

Learning by sight

Plastic working models of airplanes and other mobile equipment have reached a high state of perfection during the war. These mockups have gone far to prove what an important role plastics will play in future training programs

WE have always been a great people for learning by doing. Over the years, educators have taken cognizance of this trait and gradually reshaped their teaching methods to turn it to account. But it took a national emergency, World War II, to put whole classes of instruction in the "learning by seeing" category.

One military school that has made extensive use of this type of training is the Army Air Force Service School, West Technical Training Command, located at the Santa Monica plant of the Douglas Aircraft Company, Inc. Here almost every mechanical part of a C-54B airplane has been reproduced in transparent plastic working models. By handling these mockups and observing the movement of the fluids in the various systems, a student gains a clearer picture of what makes a plane operate than he could ever achieve from an examination of the exterior of metal pipes and housings supplemented by verbal descriptions.

Shaping a program around transparent models

The completeness and the intricacy of the plastic working models is clearly pictured in the accompanying four-color illustration. This close-up of a model of the fuel system on the C-54B airplane includes one of the six main fuel tanks (left foreground), the two round auxiliary tanks, the control pedestal and the instrument panel. The student is throttling the No. 2 or left inboard engine.

All six of the main fuel tanks in this transparent model were made from $^3/_4$-in. thick Lucite sheet while the round auxiliary tanks, which are actually located in the fuselage of the C-54B, were constructed from $^1/_8$-in. thick sheets of the same material. The long joints in all the tanks were achieved by masking off the methyl methacrylate sheets with animal glue and soaking the exposed surfaces in methylene chloride for approximately 30 minutes. The component parts were then clamped together under light pressure in an appropriate jig for a minimum of 24 hours.

All the other plastic parts of this model fuel system except the piping were being cemented together in the manner described above. This group includes the control pedestal, which the student is operating in the color illustration, the engine firewalls, one of which is visible just behind the oblong fuel tank in the foreground of the color picture, the carburetors, the various valves and the brackets.

The tubing which pipes the fuel through this model system is extruded Tenite II, bent to the desired shape by a process developed by the Douglas Aircraft Co., Inc. And the fuel is kerosene dyed green to facilitate observation. Perhaps one of the most remarkable features of this mockup is the ease with which it can be maintained. When operating 8 hours a day, the unit requires only half an hour's service each week.

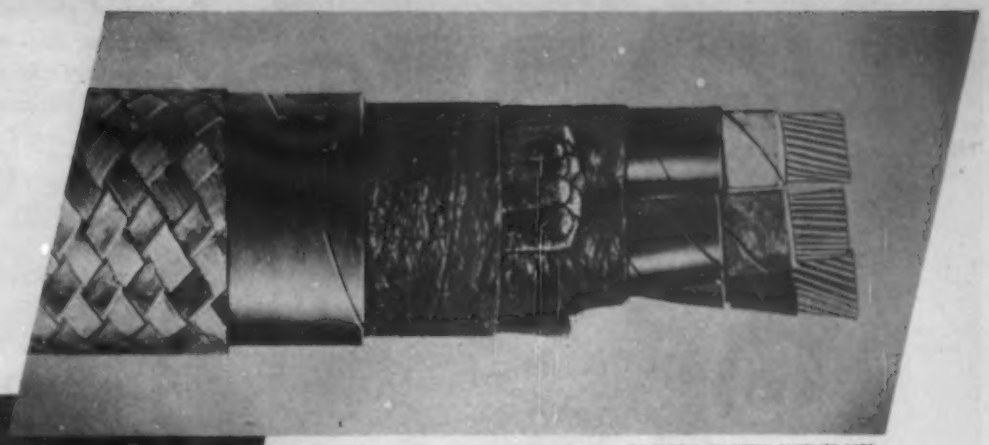
The hydraulic system on the C-54B has also been reproduced in plastic at this school. In this case all the component parts are full size and operate exactly as do their counterparts in the actual plane. The only differences are that the elements of the mockup are somewhat crowded to conserve space and operate at a pressure of 200 p.s.i., whereas the actual system functions at 3000 p.s.i.

As in the model of the fuel system, the main parts of this mockup are machined from blocks of methyl methacrylate and then cemented together. The various subassemblies of the hydraulic system are then mounted on $^3/_4$-in. thick Lucite bulkheads. Just as the kerosene used to simulate gasoline in the model fuel system was colored green to facilitate observation, the fuel in this second mockup was colored red.

KODACHROME, COURTESY DOUGLAS AIRCRAFT CO., INC.

To facilitate the training of student airmen, full scale models of the working parts of the C-54B airplane are fashioned from methyl methacrylate sheets and blocks at the Army Air Force Service School, West Technical Training Command, California

These elastomeric compounds can be molded, extruded, calendered or used as a fabric coating in a variety of products. For example, the extruded type provides multi-layered protection of marine cable. The same type compound when calendered on a cloth base makes a non-skid floor mat or stair tread



ALL PHOTOS, COURTESY BAKELITE CORP.

Elastomeric compounds

by STEPHEN J. WILSON*

By compounding vinyl chloride-acetate resin with a plasticizer to provide flexibility, a much needed class of flexible, resilient plastics has been obtained. Depending upon the amount of plasticizer used, the flexibility of these materials varies from a soft rubbery state to semi-rigidity. These so-called elastomeric compounds have excellent water resistance, high dielectric strength, oxidation resistance and resistance to weathering, abrasion and flexing. They possess slow-burning characteristics, are resistant to oils, greases and most chemicals and, when specially formulated, are non-flammable. In addition, they can be produced in a complete color range.

As for processing, these flexible resilient plastics are available as molding compounds, extrusion compounds, flexible sheeting and film, and cloth coating compounds.

Either the compression or injection method can be used for the forming of the molding materials—injection being the most commonly used process. By this method such parts as automobile windshield weather stripping, bumpers, and grommets can be molded easily and economically.

Using a screw-type extruder, a wide variety of functional and decorative products can be formed from these elastomeric compounds. These range from laboratory tubing to automobile door seals and tubing insulation.

By calendering these compounds, flexible sheeting and film is produced which combine utility and "eye appeal." Not only can the sheets be produced in a wide range of colors but the calendered finish is satin-like in texture, a characteristic that opens many fields of application.

And finally, by combining these elastomeric compounds and fabrics, a coated fabric can be produced.

NEW materials have an accelerating effect on the plastics industry for, by opening up new fields of application, they increase the usefulness as well as the usage of plastics. Starting with phenolics, the first modern synthetic plastics were rigid materials. With the development of each new rigid material—among hem ureas, polystyrene, vinyls and melamines—the plastics industry made greater strides forward until these plastics, both thermosetting and thermoplastic, were serving efficiently throughout industry and taking their place in almost every walk of life. As rigid materials, however, their range of application is limited since they are not applicable where specifications call for flexibility. In answer to this demand, the laboratories of Union Carbide and Carbon Corporation developed from one of these rigid materials a class of flexible, resilient plastics. These new materials were called elastomeric compounds and sold under the trademark Vinylite.[1]

These relatively new materials are obtained by compounding vinyl chloride-acetate resin with a plasticizer to provide flexibility. This flexibility varies from a soft, rubbery state to semi-rigidity, depending on the type and amount of plasticizer used. Excellent water resistance, high dielectric strength, oxidation resistance, and resistance to weathering, abrasion and flexing are among their most noteworthy properties. They are also resistant to oils, greases and most chemicals, and they possess slow-burning characteristics. When specially formulated, these compounds have been found to be non-flammable.

In addition, these compounds can be produced in a complete color range. Consequently, they are an important factor wherever color is specified as integral in the product. Since their introduction a few years ago, industry has found a wide

* Bakelite Corp.

[1] Vinylite is a registered trademark of Union Carbide and Carbon Corporation.

Typical of the many and varied uses of flexible vinyl films are tobacco pouches and industrial tapes. Cut from special types of film the tapes are used as insulation. The pouch has been found to keep tobacco fresh and moist for a long period

use for them as flexible materials which can be molded, extruded, calendered as sheeting and film or coated on cloth.

Molding compounds

As molding materials, elastomeric compounds are formable by either the compression or injection method, although the latter is more commonly used and generally is the more desirable. By this method, they can be molded easily and economically to form an almost endless number of flexible products—from automotive windshield weather stripping which must be resistant to rain and ice, to a distributor cap nipple which must resist the destructive force of ozone.

Motorists who have been forced at one time or another to pump up a "flat" after air has seeped out of a tire will appreciate tire valve caps molded of elastomeric compounds. Such plastic caps automatically thread themselves when first pressed on the valve stems and adhere tightly—consequently air cannot escape readily through the valve stem nor can extraneous substances enter it.

At overseas supply depots, G.I. drivers have stepped on the starters of new trucks and been rewarded instantly with the smooth rumble of the engine beneath the hood. The efficient performance of the engine was assured by small plastic plugs. These plugs molded of elastomeric compounds were fitted firmly into the vent holes of distributor caps when automotive vehicles were shipped overseas. They acted as protective seals against moisture and other elements which might attack the vital parts of the distributor. When the vehicle reached its destination the plugs were pulled and the distributor was ready for use.

Bumpers molded of these compounds eliminate noise from slamming elevator doors or rattling truck hoods and at the same time decrease wear. Molded grommets assure the unfaltering performance of many types of equipment under all conditions and in all climates since they resist water, oil, chemicals, aging and abrasion. Molded wire terminal sleeves protect and insulate connections in wiring systems of airplanes.

Tomorrow, flexible molded plastics will be found increasingly in the automobile as weather stripping, pedal pads and knobs, soft and flexible, yet extremely durable. They will appear in the home as furniture knobs, electrical plugs, colorful toys that will withstand rough handling, and kitchen appliances keyed to the color harmony of the kitchen but resistant to oils, greases and fruit acids. In industry they will offer lasting service as printing rolls, control knobs, pump suction cups, gaskets, washers of various kinds, floor mats and window seal sections.

Extrusion compounds

These flexible materials emerge from a screw-type extruder as a wide variety of functional and decorative products. They are used by industry as chemical laboratory tubing, beer tubing, electrical conduit tubing, temple rolls, typewriter platens, machinery bumpers, automobile door seals and automotive wind lacing. In the postwar era, these parts will be produced in various colors to match the color scheme of a car, or to provide the proper contrast with it. Consequently, they will remove the discordant note present in today's car design where black stripping is in glaring evidence. Or they will eliminate costly garnish fixtures often used to cover up black gasket parts. The flexible character of these elastomeric plastics enables gaskets to be stretched over glass sections with ease. They fit completely around the glass windshield or window, serve as a flexible seal between the glass and the metal frame, and offer adequate protection against the elements as well as giving the glass a resilient material on which to ride.

Flexible plastic insulation which possesses high dielectric strength and is resistant to water, chemicals and flame, provides excellent mechanical protection and electrical insulation for wire and cable under all conditions of service. This type of insulation protects the vast network of wires functioning as overhead lines from severe weather, and resists the oxidizing attack of air or ozone and the age-accelerating effects of sunlight. It protects wire and cable lying in contact with acid or alkaline soils, dragged over rough terrain by heavy-duty equipment, and installed in plants where exposure to chemical fumes, oil, grease, gasoline or alcohol is involved. On shipboard, flexible plastic insulation protects the complex

electrical circuits of seagoing vessels from oil and chemicals, water and flame.

During the war, flexible plastic tubing insulation which remains flexible at temperatures of -50° F. assured the unfaltering operation of gun turrets and electrical equipment of high-altitude aircraft. Wherever certain sections of the wiring installation were subject to unusually severe abrasion and wear, as in flexible connections to aircraft turrets, "spaghetti" tubing was placed over these sections to prevent the primary insulation from being cut. When used as connector sleeving or terminal insulation, flexible plastic tubing covers the wires that were stripped bare when soldering the terminals. Here the tubing acts as primary insulation for the wire. Both the "spaghetti" tubing and wire are usually stamped, or marked distinctively, so that the maze of wires required on aircraft are easy to trace. In this respect, all plastic wire and cable insulation is of value in maintenance work, since it can be produced in various colors to provide quick and positive circuit identification in the most complicated assemblies.

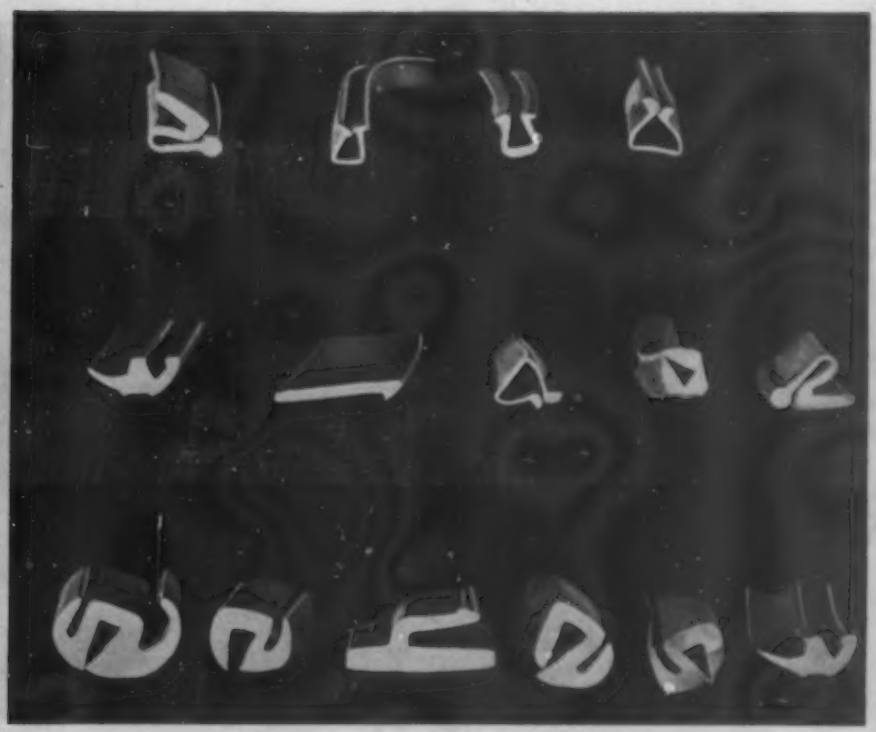
Flexible sheeting and film

Flexible sheeting and film produced by the calendering of elastomeric compounds are materials of utility and "eye appeal." The former because they are resistant to tearing, abrasion and scuffing, and are unaffected by mold, mildew, water, oil, grease, alcohol and many corrosive chemicals. They appeal to the eye because they can be produced in transparent, translucent or opaque colors, in pastel tints or brilliant hues. Their calendered finish, satin-like in texture and attractive for many purposes, can be given a high sheen by press-polishing.

Sheeting—High-gloss plastic sheeting produced in this manner has become increasingly popular as a material for handbags and shoe uppers. Wiping with a damp cloth easily cleans its surface and restores its original luster.

Other varieties of flexible sheeting are extremely long-wearing and have been used for abrasion-resistant shoe tipping and foxing, and waterproof shoe soles. (Soles that will not leave dark streaks on floor surfaces, or readily slip on wet floors.) While shoes and handbags are commodities in the female market, flexible plastic sheeting has been used to make men's haberdashery—wallets, belts and suspenders—more enduring and attractive.

Since flexible plastic sheeting is resistant to sun and salt water, it was widely adopted by the Army and Navy Air



Three different methods of processing are shown in the accompanying illustrations. The tiny wire terminal sleeve at the left was injection molded of transparent non-rigid vinyl. It acts to protect and insulate wiring connections of aircraft. The water bottle (lower left) was fabricated of this same type of vinyl compound which had been made into sheets. The extruded strips (below), available in rich and varied colors and with a high gloss, can be produced in the most complex shapes

Forces for use in survival kits. Fliers were provided with a small solar still which was capable of converting sea water into fresh water for an indefinite period of time. This still, fabricated from flexible plastic sheeting, could produce from a pint to a quart of fresh water in 8 hours.

A desalting bag made of flexible sheeting was also used to convert salt water into fresh water. The bag, resistant to salt water and the action of the chemical briquets with which it was supplied, provided six pints of drinkable water yet occupied only the space of a one pint can. Flexible plastic sheeting also served with the armed forces as aerial delivery bags which contained water or other liquids and were dropped by parachute to isolated units of troops. Flexible water bottles assure pure fresh water to survivors of torpedoed ships, and flexible canteen bags protected rations and personal belongings from moisture and insects.

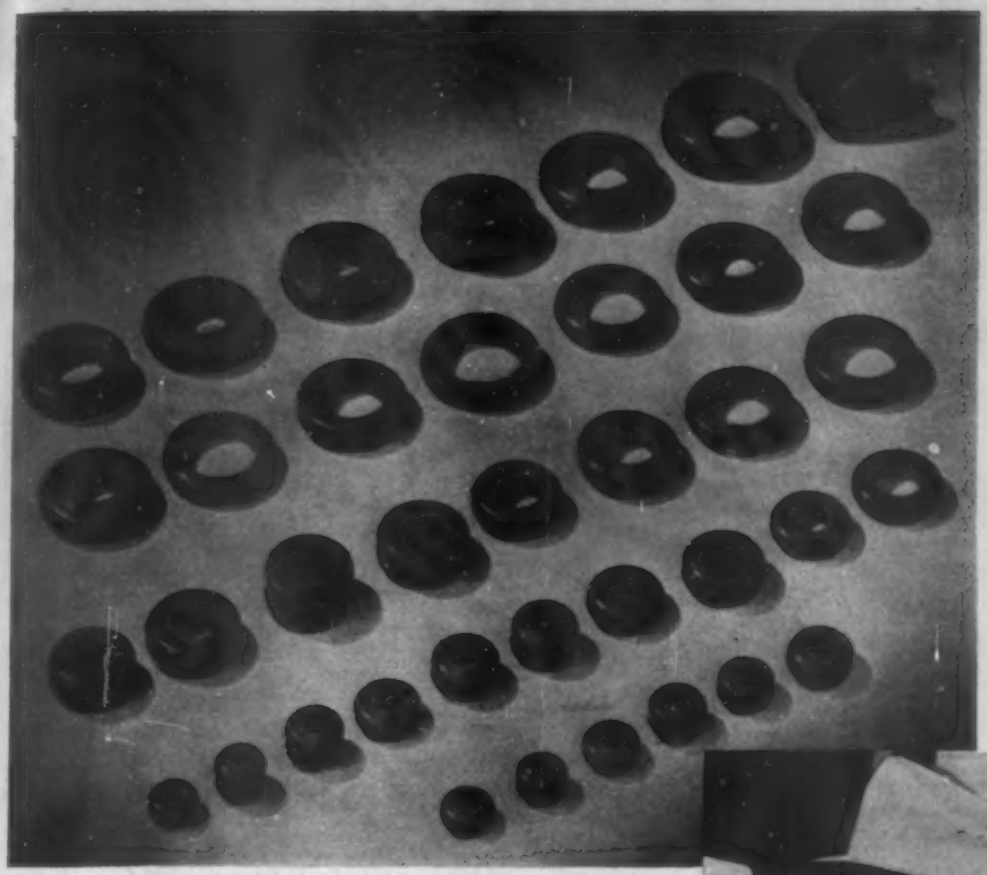
Film—During beach-landing operations, servicemen's rifles were protected from sand and salt water by flexible plastic films which were knotted at one end by the bearer before he left the transport. In emergencies the weapon could be fired while incased in the envelope. These films also served as pistol covers which were tailored to fit the contours of side-arms, and as waterproof and greaseproof packages for ordnance and other equipment.

They have contributed materially to the field of medicine as irrigation bags used in the treatment of burns. Such bags, placed over burned limbs and irrigated with a suitable solution, eliminate infection danger and speed the regrowth of healthy skin.

Flexible plastic films are widely utilized to provide electrical and protective insulation on many types of circuits, including automotive and aircraft lighting harnesses, naval and industrial power cables, and bus bar distributor systems. The films are applied by wrapping and are often heat-sealed to obtain continuous insulation.

Transparent colored raincoats of flexible film are waterproof, light in weight, strong and durable. For the housewife, flexible films make especially practical household smocks and colored aprons which are unaffected by spilled foods, are easy to clean and protect the daintiest of garments. Attractive

Such tiny pieces as seals for distributor cap vents (top) can be produced by molding these elastomeric compounds. When calendered into sheets the material is adaptable for use as strips from which backs and seats of chairs can be constructed (center). Or the sheeting can be used for the trim and uppers of all types of women's shoes (left)



This elastomeric vinyl type material has been used for the molding of uncounted numbers of grommets. Produced in a variety of sizes, the grommets are unaffected by moisture, wear, oils and chemicals. In an entirely different form, as a fabric coating, this plastic compound is used for hospital sheeting

shower curtains, window curtains, and drapes of these films brighten the home and reduce tedious housekeeping since they do not pick up dirt readily and are quickly cleaned.

Cloth-coating compounds

The combination resulting from fabrics plus elastomeric compounds yields a coated fabric that is attractive, durable and long-wearing—armored against moisture, chemicals and abrasion. Cloth, coated with these flexible plastic compounds, is capable of withstanding extensive flexing. Even at low temperatures the material does not become brittle. This is substantiated by the fact that it was used by the Army for Alaskan shelters. These portable arctic shelters were made of two thicknesses of plastic-coated cloth separated by a layer of glass wool insulation. The shelters remained dry and warm regardless of biting northern winds, and the coated cloth withstood continuous exposure to wind, rain, snow and sun.

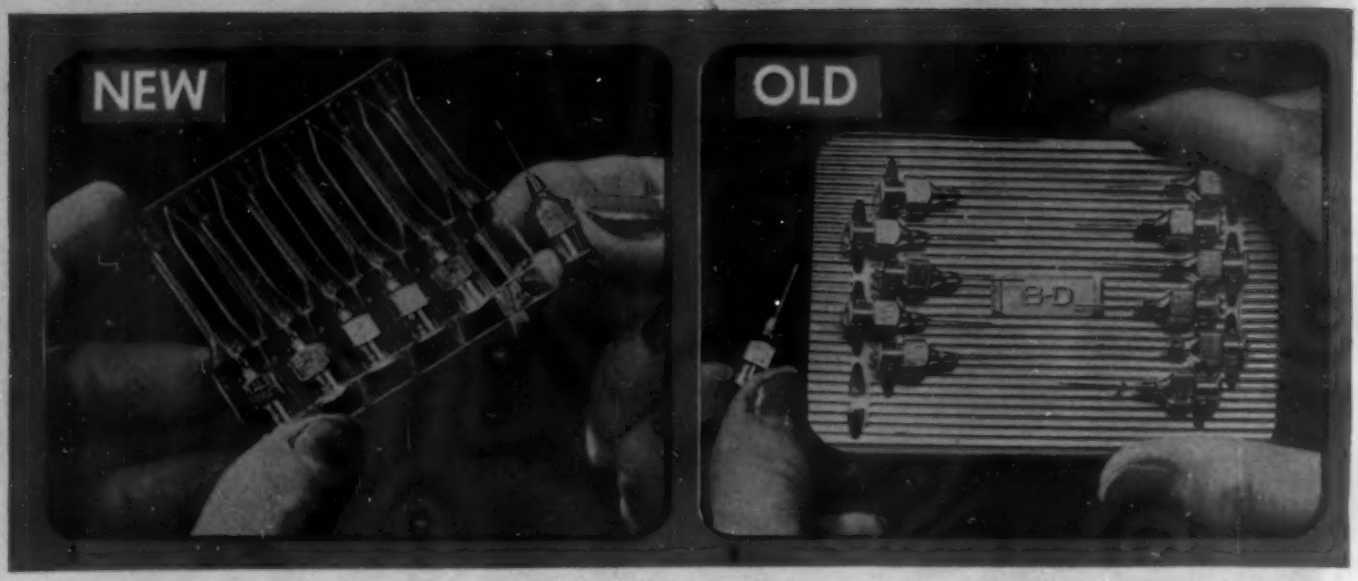
Paulins cloth, coated with elastomeric plastics, literally enables airplanes to carry their own shelter. Upon landing in a locale where there are no hangers, planes can be covered with lightweight paulins as protection against snow, ice, rain and tropical heat. When ready for flight, planes shed their coverings and take-off before becoming affected by weather conditions or temperatures.

Cloth, coated with these flexible plastics, is unusually resistant to oxygen and ozone. Oxygen bomb tests, conducted on resin-coated cloth for Army raincoats, proved it to be completely immune to oxidation. Army ponchos, consisting of nylon coated with elastomeric compounds were valuable additions to a fighting man's rainwear. They also served in various capacities as foxhole covers, ground sheets to protect men and equipment from ground moisture, moisture-impervious bedrolls, or shelter half-tents when two or more were laced together.

The greatest potential value of the cloth and flexible plastic combination probably lies in its use as an upholstering material to lengthen the life and improve the appearance of home and office furniture, bus and automobile seats. This material which is comfortable to the user as well as being resistant to rough usage, was used during the war under a wide variety of service conditions in planes, jeeps, tanks and combat vehicles.

Cloth, coated with flexible plastics, has also been widely employed for industrial protective clothing, field kitchen food bags, water-resistant pontoons, flexible truck covers and non-skid aircraft floor mats, which enabled bomber crews to maintain their surefootedness when their planes were being buffeted around by rough air or blast from exploding ack-ack shells.

This summary of present-day applications of elastomeric plastic materials is only a slight indication of the important role these plastics will play in the postwar world. Since they are easily fabricated, long-lived, resistant to sunlight, moisture and chemicals, and can be produced in a wide variety of colors, their range of application is almost endless, their possibilities almost infinite. And the designers and engineers who become better acquainted with these new elastomeric plastic materials will undoubtedly find many more attractive and practical uses for them.



1—Hypodermic needles are packaged in strips of six in acetate which is slit and formed to hold each needle individually and protect the extremely delicate point in a channel drawn 1/8-in. deep. 2—Formerly the needles were clipped to a sheet of brass, leaving the points exposed and liable to dulling or damage

Point protector . . . drawn from sheet

Transparent cellulose acetate packages not only hold a row of hypodermic needles firmly in place but they protect the needles without touching them

HYPODERMIC needles are a large-volume item of ethical manufacture with which the general public usually comes in contact only in a painful way. Yet doctors and nurses say that a *very sharp* hypodermic needle causes no pain.

The considerate doctor uses each needle only a few times, for even the penetration of flesh is sufficient to dull its infinitely fine point. Thus the sale of hypodermic needles amounts to several million yearly, and the manufacturer who wins the reputation for supplying needles in the sharpest condition is in an enviable position.

Obviously, a dozen needles cannot be allowed to rattle around in a box. Standard practice has been to immobilize and protect them in some way—usually by affixing each needle firmly to a cardboard or to a metal plate that is held within a rigid box.

Becton, Dickinson & Co., a leading manufacturer of needles, had what was considered a satisfactory package of this type before the war. A sheet of tensilized brass was punched in a sort of stapling effect, so that two prongs were brought up to hold firmly the neck of each needle. Snapped between these springy prongs, the needle could be expected to stay put. The point itself, however, had no real protection against damage in handling.

Wanted—added protection

About two years ago, when brass became unavailable for this purpose, this needle manufacturer brought their problem to Design Center, Inc. They explained the necessity for absolute protection of the needle point. They wanted a compact, convenient package—a device that would safeguard a dozen sharp-pointed hypodermic needles at least as well as the brass plate had.

While they were about it, they suggested a possible improvement. It is not economical to package less than a dozen needles; yet the purchaser often wants only two or three, and the druggist will usually oblige by "breaking" a package. However, when he does this, the needles lose their package protection and may easily lose their sharpness before use, reflecting discredit on the manufacturer.

Becton, Dickinson thought perhaps something on the lines of the metal holder could be worked out in cardboard. Their idea was that the cardboard could be scored so that the druggist, in breaking a package, could tear off two, three or any desired number of needles, and still leave the remaining needles attached to the board for protection.

A transparent acetate holder meets the need

The supplier, however, had a better idea. From his experience in working with plastics, he thought a sheet of transparent cellulose acetate could be formed in such a way as to firmly hold a row of needles along their whole length while protecting the points—an improvement on the prewar package. The strip of plastic could be scored so that sections holding individual needles could be torn off and dispensed as desired. Furthermore he had an automatic forming machine, of his own design, which he thought could be adapted so as to do this job at high speed.

The resulting package is shown in the accompanying illustrations. It admirably combines protection, convenience, economy and even eye appeal—every feature the manufacturer wanted, along with some he hadn't thought of. The

package (patent applied for) is so popular with the manufacturer, the druggist and the physician that there is no thought of returning to metal.

The material is 0.020 in. thick Lumarith. A channel 1/16 in. wide and 1/8 in. deep protects the point of the hypodermic needle, while the heavy base of the needle is clamped in a U-shaped end section with a "dimple" that fits up into the open end of the needle base. The dimple and the spring action of the cellulose acetate itself hold the needle so firmly and rigidly that there is no possibility of its shaking loose in the package or in the pocket; yet it is a simple matter to snap needles in or out of the holder.

Score lines between sections are closely controlled so that the sections will not break apart without force yet may easily be broken off as wanted. So completely are the sharp needle points protected by the plastic that the physician may carry a partial package in his pocket with perfect safety—something that has never before been possible.

A plus value of the acetate holders is that their transparency permits the physician to examine the needles without touching them. And the plastic has a laboratory-clean sparkle that enhances the ethical quality of the product. Needles are packaged at the factory in strips of six; two strips fit together in dovetail fashion in a package of 12.

Forming the needle holders

The plastic forming operation has several interesting features. The depth of the draw on the tiny needle channel and the severity of the formed angles tax the material to the utmost and are considered difficult to accomplish even with hand methods. Yet in this case the forming is done rapidly and automatically, on only two pieces of machinery.

In the first step, a web of cellulose acetate 8 1/2 in. wide is fed into the drawing machine to a predetermined length sufficient to make 18 spaces for needles. The heated die which forms the critical longitudinal bend at the base of the needle channel is set at an angle, and the material is brought up against it. At the same time, the die cuts the slits, about 1 in. long, pulls the material together and draws the narrow needle channel to the required 1/8-in. depth. The round dimple which will fit into the needle base is drawn simultaneously to a depth of about 1/16 inch. The same knife-edge that cuts the slit also completes the score mark across the remainder of the width of the material.

3—Two strips of six needles each are dovetailed together in a compact package. Box which holds them is shown in foreground. 4—The holder is scored so that individual units, or as many as desired, may easily be detached for separate sale, with protection still intact. 5—Holders are automatically formed in strips of 18 units each. Result of first forming operation is shown at the left. Final bend is formed (right) in a high frequency heating apparatus without distorting the rest of the work

At this point the work is complete except for the fina bend which forms the base of the holder. This bend must be made without distorting the dimples, which are essential to securing the needles. A heated blade, it was found, would hopelessly distort the material. The problem was solved by electronics.

The strips are fed into a high-frequency heating unit which applies instantaneous heat along a line only 1/32 in. wide. Automatic timers turn off the heat on a split-second cycle as an arm comes up and turns the edge to the desired angle.

Strips can be produced thus at the rate of 6000 to 7000 units a day. Already, strips sufficient to package more than 4,000,000 hypodermic needles have been turned out.

Obviously, the principles of this point protector may be adapted to many other products which will similarly result in better protection, visibility and convenience in handling.

—Five methyl methacrylate parts go into the construction of this height finder. They are the two eye pieces, two transparent slides and a single small black calibrated dial

3—The illuminated magnifier is available in two models. The head of both instruments and the body of the 110-volt unit are molded of cellulose acetate

Magnifiers—for laboratory and field

THE reason for the use of magnifiers is a desire for meticulous accuracy and detail. To achieve this end the component parts of these instruments must fall within very close tolerances. An eye piece that is a fraction oversize or a frame that is a trifle out of line can nullify the most painstaking effort of the researcher.

Advertising Displays, Inc., manufacturers of adjustable magnifiers, illuminated magnifiers, height finders and stereoscopic photographic equipment, has found that the dimensional stability of plastics makes them admirably suited for use in its line of equipment. And the light weight of these materials is an added advantage since many of the magnifiers are meant to be carried around from place to place.

The height finder

Take this company's height finder as an example of judicious use of plastics (Fig. 1). This small compact instrument is used for measuring parallax, the determining factor in finding differences in elevation from stereoscopic overlaps of aerial photographs. As can be imagined, the finder was used extensively throughout the war by the Air Forces and Signal Corps. In peacetime it should prove invaluable in the mapping of undeveloped areas of the world and in other civilian pursuits to which aerial photography will no doubt be applied.

There are five Lucite parts in this height finder—two eye pieces, two transparent slides and a small calibrated dial. Four of these pieces are shown disassembled in Fig. 1. All five parts are injection molded of methyl methacrylate by Recto Molded Products, Inc., and then are assembled with the remaining parts of the instrument.

Two models of the illuminated magnifier

For simple magnification as contrasted with the more com-

plicated functions of the height finder, Advertising Displays, Inc., has numerous instruments, each designed for a specific need. For instances where the magnifier is to be taken to the object under examination—reversing the more accepted practice of bringing the questioned matter to the laboratory for study—this company has designed a magnifier that somewhat resembles a flashlight in construction.

Two models of this instrument are available. One operates on two standard "D" size batteries while the other is fitted with a 7-ft. extension cord and can be plugged into any 110-volt power outlet. The heads of both models are identical, being molded of Tenite by the same molding company responsible for the plastic parts in the height finder. Using the same material this molder also produces the base of the 110-volt illuminated magnifier which is shown in the background of Fig. 2. The only other plastic part is the end cap on the battery model.

Both these units were designed originally for the Army Air Forces, first to conserve metal and secondly to reduce the cost. However, they both are finding extensive application in the inspection of metals, machine parts, fabrics, leather, building construction materials and jewelry, or in fingerprint classification, stamp examination and photo interpretation. For cases where scales or rules must be used beneath the lens, a special cut-away head is available. This arrangement is particularly useful when maps, charts and photographs are being examined and interpreted.

The tube magnifier

At the other end of this company's line of magnifiers is the tube magnifier shown in Fig. 3. Portable, like the illuminated models just discussed, this instrument fits right into a pocket. In fact, it is not much larger than the picture of it reproduced on this page. To guard the bottom glass disk with its two graduated scales against accidental scratching, a leather case is furnished with each magnifier.

Both the transparent tube and the eye piece of this instrument are molded of Lucite. This second part is fitted with ground and polished five-power lenses. Focusing is accomplished by rotating the eye piece until the scale is in correct adjustment. The advantage of the clear plastic tube is that light can pass through the walls, assuring adequate illumination over the entire field of view.

Used by the Armed Forces for scaling maps, aerial photographs and for similar purposes, it is employed by engineers, architects and others intent upon close measurements in decimal parts of feet or millimeters.

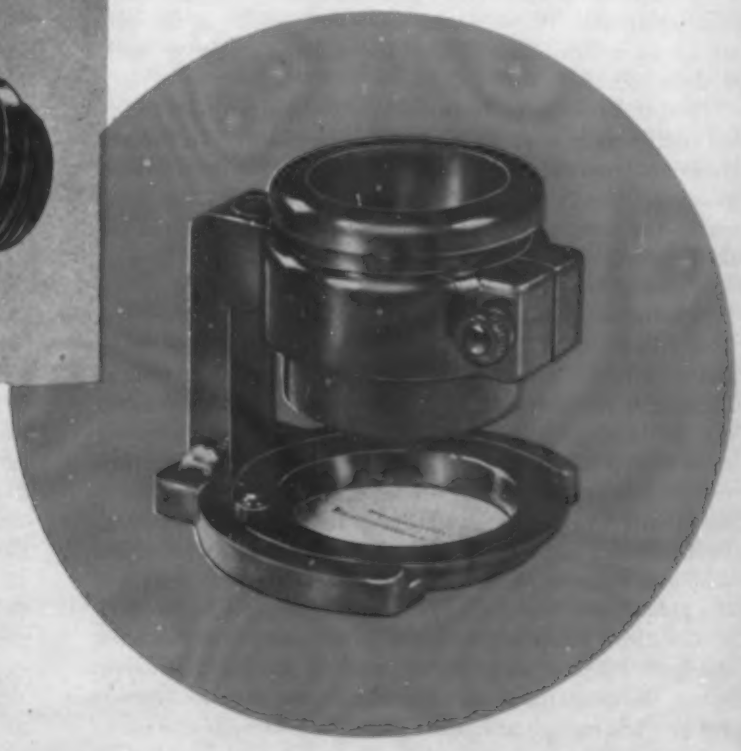
The focusing magnifier

Just as compact as the tube magnifier but designed for tabletop work, the focusing magnifier shown in Fig. 4 might be termed an all-plastic instrument. Except for the calibrated glass disk in the base, the lenses with fiber spacers and the screws, all parts of this magnifier, are molded of Durez by Plastic Moldings Corp. And even one of the screws is partly plastic—the holding screw in the base being topped with a phenolic knob.

The applications of this unit are varied. Interchangeable disks for Henry, Battley and Moran Codes are available for police and identification bureaus. Fitted with a disk with scale graduations of 0.001 ft. the magnifier is adaptable to surveying, chartography and engineering work. Or it might be used in grading and inspecting fabrics, dies, printed matter and engravings.

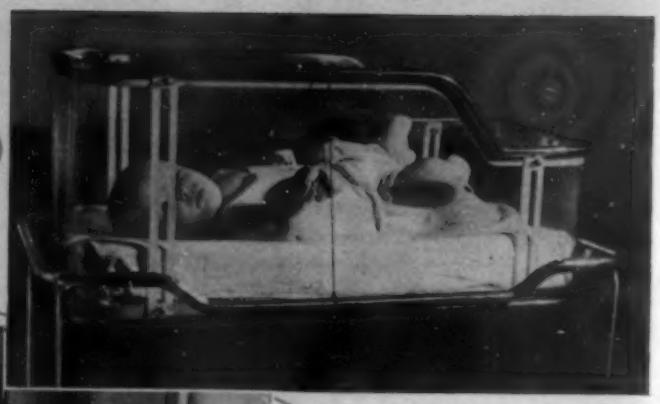
Whichever instrument is employed, regardless of the application, plastics play an important part in its successful operation. The precision with which the various molded parts can be produced, the light weight of the material and the reductions in production costs made possible by the adoption of plastics—all these elements have combined to make an improved line of magnifying instruments.

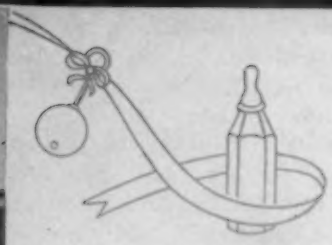
3—Both the tube body and eye piece of this instrument are of plastic. The clear body has the advantage of allowing light to pass through its walls, thus assuring adequate illumination



4—All parts of this focusing magnifier are molded of phenolic except for the calibrated glass disk in the base, the lenses with fiber spacers and the screws in the molded phenolic top and the base

Transparent Bassinet





Since children in cribs with transparent cellulose acetate or vinyl resin sides are on constant display, the walls can be built high enough to hinder the passage of bacteria from crib to crib

EVER since physicians and scientists first became aware of the importance of eliminating cross-infection of babies caused by airborne bacteria, the nursery bassinet has constituted a peculiar problem. If the sides are high enough to hinder the passage of bacteria from crib to crib, they hinder observation of the children by nurses and parents. Compromise solutions to this difficulty whereby the sides of the crib are of an intermediate height are unsatisfactory on both of these counts.

Then there is the problem caused by the strap steel banding traditionally used for the sides of bassinets. To protect the infant from these bands it is necessary to use considerable padding. But this padding tends to soil easily and tear, adding to the linen problem. It also reduces the free area for the handling of the child in the crib.

A plastic bassinet developed by Dr. J. W. Boren of the Marinette General hospital offers a solution to these difficulties. This crib is built with cellulose acetate or vinyl resin sides, and acrylic side and end pieces set into metal edge tubing. Because of the transparency of the plastic materials the crib can be designed with a much greater depth—thus assuring more complete isolation of each child. And at the same time visibility is enhanced many times due to the elimination of metal supports and cross bars and the protective padding. Furthermore, these bassinets are easy to clean with either soap and water or alcohol, and the smooth resilient surface of the plastic is an insurance against the child injuring itself.

The Lloyd Manufacturing Co., processors of this bassinet, use both Fibestos and Vinylite sheeting for the transparent sides. Both materials mold easily to the rounded corners yet are rigid enough to support over 200 lb. of weight on either the side or end walls without pulling out of the upper or lower steel frames, or bending. The bottom and top edges of the plastic sheet are slipped into this metal framework to a depth of approximately $1/2$ in. while the side edges are inserted, again to a depth of $1/2$ in., in a routed Plexiglas or Lucite upright. There is no bolting or cementing of the sheets.

The acrylic resin supporting post is $1\,1/2$ in. wide and $1/2$ in. thick and is routed out for $1/2$ in. on either side to receive the ends of the cellulose acetate or vinyl resin sheets. An opening $1/2$ in. wide is cut through the length of this post. As with the transparent sides of the crib, this acrylic upright does not in any way hinder visibility. Looking through the post with two eyes, the frosted or routed edges are almost unnoticeable.

It is a simple matter to convert this bassinet into an incubator by placing a tight closure over the top and applying the customary heat and oxygen and the humidifier bottle. Thus a baby need not be moved from crib to incubator or from incubator to crib. And throughout the entire period of treatment visibility is perfect.

The height of the transparent sides are varied so that the foot end is lower than the head to permit the nurse, while handling the baby, to reach into the drawer, set into the frame, without walking around to the other side of the crib. The construction of the basket is such that it can be easily assembled or disassembled. It is possible for any one or for all the transparent cellulose acetate or vinyl resin side sheets to be removed and replaced at the hospital. This is an important factor, especially now when all types of equipment are in such constant and urgent demand. A. M. Clark Co. is the sole distributor of this crib on which Dr. Boren holds all of the patents.

Bagasse resin laminates

by T. R. McELHINNEY*

PREVIOUS articles[1,2] have discussed the production of phenolic-type thermosetting resins from bagasse, the fibrous, ligno-cellulosic material remaining after the extraction of juice from sugar cane. The use of these resins as binders in the production of laminates has been mentioned, but no information has been published on what physical properties might be expected from the combination of these resins with various fillers.

Two resins suitable for use as bonding agents, Valite Resins Nos. 8123 and 8142, have been developed at this laboratory. Both of these resins are thermosetting and are similar to the phenolics in handling characteristics. Chief differences between the two resins are in their viscosities and curing characteristics. The former is a quick-curing resin and has a viscosity of from 350 to 500 cps. in 55-percent alcoholic solution; the latter is somewhat slower-curing and has a viscosity of approximately 3000 cps. at the same concentration. The latter is somewhat more difficult to use because of its low penetrating power, but has the advantage of producing a very flexible bond and appears to be well adapted to postforming operations. Physical characteristics of finished laminates made with either of these resins are very similar, except for the increased flexibility and somewhat higher impact strengths obtained with the type 8142 material.

The basic resin used in the manufacture of the two products is produced by a high-pressure digestion of bagasse. This resin is a semi-solid material practically 100 percent soluble in alcohol and acetone. In this state, it is used as a binder for thermosetting molding compounds, requiring only the usual addition of hexa or other hardening agents. It is of little value as a bonding agent for laminates in this form and must be subjected to further processing to make it more soluble and to increase its penetrating power. At the same time sufficient formaldehyde is added to make it heat-hardenable. The finished resin comes from the autoclave as an alkaline, alcoholic solution of pH 8.5 with a solids content between 55 and 60 percent. The hot-plate cure time is approximately 1½ min. for type 8123 resin and 2 min. for type 8142.

The objectives of the work described herein were to obtain representative data on physical properties of laminates produced from various fillers bonded with the bagasse resins; to make a comparison of the properties obtained with each of the resins when used with the same filler; and to determine the keeping qualities of the resin in solution and of the treated filler in storage.

The resin impregnation of the various fillers was done in a home-made continuous treater. The paper or other fabric that is being treated passes over and under a series of rollers, through the pan holding the resin solution and out through two power-driven squeeze rolls which remove excess resin. The impregnated paper passes from the squeeze rolls to the top of the 24 by 24-in. by 8-ft. high vertical drying tower and down between two banks of six 250-watt infrared lamps against a current of heated air from a 25,000 Btu. steam space heater. Drying can thus be accomplished with the use of infrared lamps, hot air or a combination of both. The last method was used in all of the work reported here. At the bottom outlet of the drying tower is a pair of commercial washing machine wringer rolls, 3½ in. in diameter. Motive power for the entire apparatus is furnished by a ¼-hp. motor through a speed reducer and a variable speed friction disk drive consisting of a 12-in.-diameter steel plate with a movable 3-in.-diameter by ½-in.-face rubber disk pressing against it. The rubber disk can be shifted across the face of the steel plate to vary the time of retention in the dryer from about 3½ to 7 minutes. Longer drying times are obtained by making a double pass. The conditions of treating and pressing the various laminates are given in Tables I, II and III.

Testing methods

In so far as possible with the equipment available, physical tests were made in accordance with the methods of the American Society for Testing Materials.[3] Water absorption tests were made by the method specified in A.S.T.M. D 570–42; impact strengths were determined as specified in A.S.T.M. D 256–43T, Method A; and tensile and flexural specimens were conditioned as specified in A.S.T.M. D 229–43 for sheet and plate material used in electrical insulation. Since no Universal testing machine was available, these tests were made on a hand-driven Dillon tensile tester equipped with suitable fixtures for making the tests. Speed of crosshead travel was closely maintained at that recommended in the specifications.

Flow was determined by pressing approximately 25 gm. (weighed to the nearest cg.) of 5 by 5-in. sheets of the material being tested under the same conditions as were to be used for laminating. Following the curing cycle, the flash was removed and the piece reweighed. Flow was calculated as the percentage of flash, based on the weight of the original sample.

Resin pickup is calculated as the difference between the weight of a sample of the treated material and the same size sample of untreated material. The percentage is calculated on the basis of the weight of the treated material.

Volatiles were determined by drying a weighed sample of the treated material for 10 min. at 160° C. Percent volatiles is calculated on the basis of the original weight of the undried, treated material.

Filler materials

Laminates were made using the following filler materials: unbleached 20-lb. Southern Kraft paper, absorbent Kraft paper, high-strength sulfite paper, 8-oz. cotton duck and heat-treated glass fabric. It should not be inferred that data obtained in these tests are in any way indicative of the best results that can be obtained with these fillers either in combination with other resins or under different conditions, or that the fillers themselves are in any way comparatively evaluated by the results of tests made with these experimental resins. Certain of these materials had been selected during the early part of this work as standard readily obtained fillers which could be used for the purpose of judging degree of improvement in physical properties as the work progressed. The high-strength sulfite paper was of particular value for judging penetration ability of various resins. The absorbent Kraft

* Technical Director, Valite Div., Valentine Sugars.

[1] McElhinney, T. R., "Bagasse Molding Compound," 1945 Plastics Catalog, p. 214.

[2] "Plastics from Agricultural Products," 1944 Plastics Catalog, p. 274.

[3] "A.S.T.M. Standards on Plastics," American Society for Testing Materials (October 1943).

TABLE I.—PHYSICAL PROPERTIES OF LAMINATES MADE WITH BAGASSE RESIN 8123

	High-strength sulfite paper	*Absorbent Kraft paper*	*Southern Kraft paper*	*8-oz. cotton duck*	*Heat-treated glass fabric*
Treating conditions					
Resin solution, percent solids	47	45	40	52	55
Dryer temperature, ° F.	220	220	220	220	220
Time in dryer, min.	7	5	5	15	4
Resin pickup, percent	48.5	40.5	43.8	48.7	39.0
Volatiles, percent	9.0	10.4	5.3	10.0	2.8
Flow	.....	5.2	2.0	5.0	.....
Molding conditions[a]					
Type of lamination	Parallel	Parallel	Parallel	Parallel	Cross
Pressure, p.s.i.	250	1,000	200	200	75
Moisture absorption, 24 hr. immersion, 1/10 in. thickness, percent	5.4	6.4	6.7	3.2	0.8
Flexural strength, p.s.i.					
Lengthwise, flatwise	27,100	20,550	22,000	18,800	19,500
Lengthwise, edgewise	26,800	27,975	20,100	21,000	34,450
Crosswise, flatwise	13,000	12,500	.....	.....	.....
Crosswise, edgewise	.....	16,200	15,600	.....	.....
Tensile strength, p.s.i.					
Lengthwise	28,600	24,375	22,100	13,150	48,550
Crosswise	14,000	17,050	11,800	8,950	.....
Impact strength, ft.-lb./in. of notch					
Lengthwise, flatwise	3.25	.....	2.33	Over 4.65[b]	.....
Lengthwise, edgewise	0.65	1.04	0.71	.....	.....
Crosswise, flatwise	1.25	.....	0.99	.....	.....
Crosswise, edgewise	0.40	1.10	0.54	.....	.....

[a] All molding was done at 310–320° F. Arbitrary curing times were 10, 20 and 45 min. for 1/16, 1/8 and 1/2-in. thick specimens, respectively. To insure flatness and eliminate possible small blisters, temperatures were dropped to 250° F. before removing the samples from the press. All of the filler material used had grain direction, so all tests, except on the glass fabric, were made on parallel laminations. Experiments not included in this paper have shown that cross-lamination gives results approximately equal to the average of the lengthwise and crosswise tests for parallel laminated material.
[b] Capacity of impact tester is only 25 in.-lb. Sample did not break with this blow.

TABLE II.—EFFECT OF AGE ON RESIN 8142 SOLUTION AND TREATED PAPER

	Fresh resin; paper pressed immediately after treating	*Aged resin[a]; paper pressed immediately after treating*	*Fresh resin; paper stored two months before pressing[a]*
Treating conditions			
Resin solution, percent solids	45	45	45
Dryer temperature, ° F.	220	220	220
Time in dryer, min.	5	5	5
Resin pickup, percent	44.0	44.6	44.0
Volatile matter, percent	8.6	4.0	8.6
Molding conditions[b]			
Pressure, p.s.i.	1,000	1,000	1,000
Moisture absorption, 24 hr. immersion, 1/10 in. thickness, percent	6.6	6.7	6.7
Flexural strength, p.s.i.			
Lengthwise, flatwise	27,825	20,825	24,650
Lengthwise, edgewise	22,700	21,125	....
Crosswise, flatwise	13,450	16,450	....
Crosswise, edgewise	15,875	16,475	....
Tensile strength, p.s.i.			
Lengthwise	23,425	21,275	26,700
Crosswise	16,750	13,375	....

[a] The resin solution and the treated paper were stored at room temperature during October and November 1944 in an unheated building where the temperature of the room was approximately the same as the outside temperature. During this season of the year in Louisiana, the temperature will vary from 40 to 90° F., with the average temperature 75° F. or higher.
[b] See note to Table I.

was used to evaluate increase in strength and to compare a resin of low viscosity and high penetrating power with one of high viscosity and low penetrating power. The cotton and glass fabrics were excellent for judging bonding strength as the possibility of wet bonding (cellulose-cellulose attraction) was virtually eliminated by the use of these materials.

Discussion of results

The results of the tests are given in Tables I, II and III. Table I shows the physical properties that might be expected with the use of type 8123 resin in combination with various fillers. This table is self-explanatory, but it is interesting to note that the properties obtained, with the exception of moisture absorption, in most cases exceed the minimum A.S.T.M. specifications for similar grades of laminates by a considerable margin. Moisture absorption is slightly higher than the minimum in most cases, but is not so great as to cause distortion of the samples. The results obtained with Southern Kraft paper are particularly interesting, as this is an ordinary wrapping paper and has probably never been considered as a filler for laminates.

Table II shows the effect of age on the resin solution and on treated paper stored at room temperatures. It is unfortunate that the quantity of treated paper saved for this test was not sufficient to make the complete series of tests. However, sufficient data were obtained to indicate that the treated material can be stored for at least two months at normal room temperatures without loss in physical properties. The laminates made from resin which had been stored for a two months' period indicate that some deterioration of the resin might have occurred, but it should be noted that this was a separate run in the treater. It will be seen that the resin was advanced slightly more during drying, as indicated by the

lower percentage of volatiles in the treated paper. Probably the slightly lower results obtained from the old resin are due to advancing the resin a little too much in the dryer rather than to any actual deterioration. The moisture absorption data would indicate that deterioration was very slight. It is felt that it can be safely assumed that both the resin and treated materials can be stored for two months' intervals without refrigeration and for longer periods of time under cool conditions.

TABLE III.—COMPARISON OF PROPERTIES OF LAMINATES MADE WITH ABSORBENT KRAFT PAPER AND VALITE RESINS 8123 AND 8142

	Resin 8123	*Resin 8142*
Treating conditions		
Resin solution, percent solids	45	45
Dryer temperature, °F.	220	220
Resin pickup, percent	40.5	44.0
Volatiles, percent	10.4	8.6
Molding conditions (see Table I)		
Pressure, p.s.i.	1,000	1,000
Moisture absorption, 24 hr. immersion, 1/16 in. thickness, percent	6.4	6.6
Flexural strength, p.s.i.		
Lengthwise, flatwise	20,525	27,825
Lengthwise, edgewise	27,975	22,700
Crosswise, flatwise	12,500	13,450
Crosswise, edgewise	16,200	15,875
Tensile strength, p.s.i.		
Lengthwise	24,375	23,425
Crosswise	17,050	16,750
Impact strength, ft.-lb./in. of notch		
Lengthwise, flatwise	.....	3.41
Lengthwise, edgewise	1.04	1.25
Crosswise, flatwise	.....	2.08
Crosswise, edgewise	1.10	.....

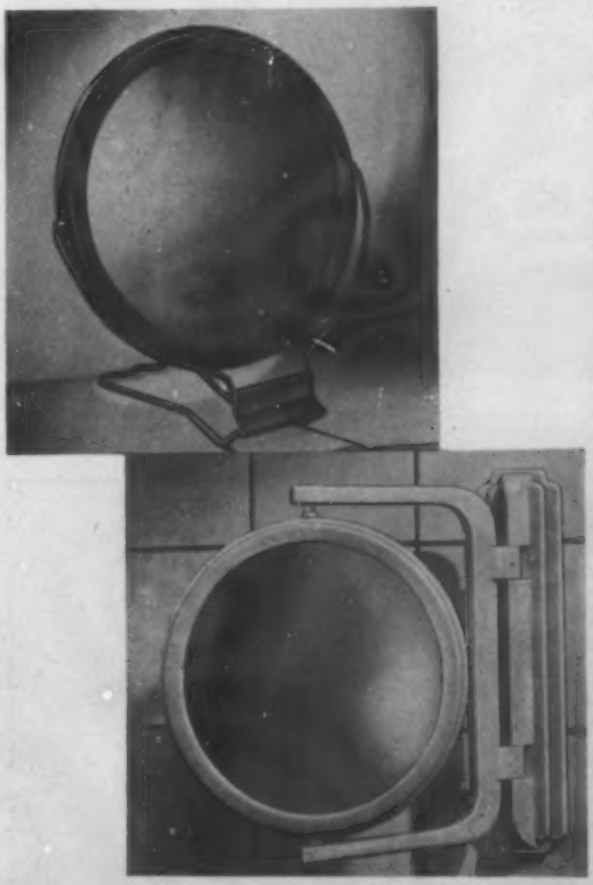
Table III is a comparison of the physical properties obtained with the two different resins. It can be seen that the average strengths of the two laminates are approximately equal. However, the fact that the laminates made with type 8123 resin show their highest strength in the edgewise direction of the sheet would seem to indicate a better penetration of this resin. Probably a great deal of the resin pickup with type 8142 material is in the form of a surface coating rather than a true impregnation. This would tend to explain the greater flexibility and also the slightly greater impact strength obtained with this resin, both of which might be due to the fact that unsaturated fibers would be less brittle than more thoroughly impregnated fibers. A factor not indicated by the results of the tests, but important for some applications, is that sheet material made from type 8142 material has a considerably better surface appearance, especially where comparatively low pressures are used.

For most purposes, Valite Resin 8123 will be found more satisfactory than 8142. Physical strengths and moisture resistance are approximately the same, but type 8123 is easier to handle than the more viscous 8142. Type 8142 is recommended where slightly higher impact is required, and it is especially indicated where some degree of flexibility in the finished piece is desirable. Indications are that this material will also be of value for postforming operations.

THE AVERAGE PERSON IS USUALLY VERY choosy in his selection of a mirror. He wants something in a light and attractive frame for his dressing table or bathroom and for hardier use—such as camping—he prefers his mirror protected by a frame as rugged as its surroundings. Here is one mirror which literally "doubles in brass", being available in a dress frame for home use or a sturdier frame for outdoors.

As originally developed for the Navy by the Consolite Corp., the two-sided, heavy-duty mirror—magnifying on one side and plain on the other—was protected by a rim injection molded of Tenite II by Nosco Plastics Div. of National Organ Supply Co. A heavy metal wire frame enabled the mirror to stand on a shelf at any desired angle or to be hung from the wall by a nail. In this garb it is now available—and eminently practicable for campers or others who must make their temporary home outdoors.

In its civilian dress the mirror wears an injection-molded cellulose acetate butyrate frame which swivels on a plastic bracket, mountable on the wall. Since both the mirror and the frame are adjustable, the former may be set to reflect in any direction or turned completely around so that the magnifying side is foremost. The heavily ribbed bracket may be fastened to the wall either by screws or by a mastic, or permanently adhesive compound, squeezed into two circular indentations on the back of the bracket. In the latter case it is necessary only to press the bracket against the wall and it stays put without any need for screws.



PLASTICS IN REVIEW

1 John Frederics has used Plexon in the fashioning of this face-flattering hat. The plastic-coated yarn drapes well and has the added advantage of not collecting dust and dirt. Further, the material can be cleaned by wiping with a damp rag

2 An intricate machining job is this Lucite propeller fabricated by Technical Plastics Co. for use in a chemical plant where corrosives in the atmosphere attack metal or even wood. Part of a velocity counter in a drying unit, the propeller is a delicate piece with slender shaft and sharp-edged blades that are carefully shaped

3 Headaches and hazards imposed by oil dripping from airplane engines to the floor of fuselage of the plane are relieved by a Servo-Unit drip pan fabricated of Lumarith sheet stock by King Plastics Corp. This lightweight pan is provided with a nozzle fixture at one end permitting a hose connection for carrying the oil outside the plane. Not the least important feature is the transparent surface which shows up drops of oil instantly indicating the presence of leaks in the hydraulic reservoir or the accumulator

4 Ingeniously constructed so as to make screws or solder unnecessary, molded Durez plugs, product of Gilbert Mfg. Co., Inc., are self-insulating and have a permanent glossy finish. Replacement of the wire, which is securely wedged in place by the prongs, may be done without the aid of tools

5 Destined for an early appearance on fairways and putting greens all over the country is a smooth-looking, long-wearing golf bag fabricated of two-tone brown and tan Vinylite. Its waterproof and mar-resistant qualities remove sudden showers and heavy-handed caddies from the array of hazards the average golfer faces. A damp cloth does the cleaning job formerly requiring tedious oiling or saddle-soaping

6 Bright red Tenite II sleeves serve to cover these plier handles, greatly increasing the practicality of the tool. The knurled surface provides a firm grip for cold hands or slip-

pery gloves. The color makes them easy to locate in grass. Another advantage of the cellulose acetate butyrate sleeves, molded by Franklin Plastics Div., Robinson Industries, Inc., for Miller-Hall Co., is the electrical insulation they provide. The sleeves can easily be applied with the aid of a hammer

7 The thread of an industrial success story lies within the dimensions of these tire cord twist spools. The spool ends are molded from a Bakelite phenolic molding material chosen for its high-impact strength and resistance to heat, abrasion, moisture and electric characteristics. Spool waists of laminated tubing are made with Bakelite phenolic laminating varnishes. Standard Products Co. and the Plastics Division of Continental Can Co., Inc., produce the spool for Industrial Rayon Corp.

8 New picker sticks, to aid the weaver at his loom, are made of Pregwood and marketed under the trademark Plyweld. These sticks are machined from blanks of vulcanized impregnated laminations of wood by the Jacobs Corp. Pretests show that the plastic picker lasts up to 12 times as long as hickory sticks because of its sturdier and more enduring qualities, an important fact as this unit is a vital one in the weaving operation

9 The wise hostess will let 'em eat cake from this attractive plate, and the combination plate and transparent cover are ideal for restaurants since they protect the contents while having them on full display. Both the cover and plate are formed from Plexiglas, Lucite, or from cellulose acetate sheet material by the Shellmar Products Co. This company has developed a new method whereby thermoplastic sheets can be drawn with uniform dimensions. After forming, the plate and cover require only a minimum of finishing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10 Bound to hit the bull's eye is this archer's bow, formed from four pieces of wood bonded together with Urea. The four parts consist of two straight lengths of yew wood, joined with fishtail cuts, a handle riser and an arrow rest. The use of the synthetic adhesive eliminates the need for finishing interlocking cuts to exact dimensions; the bow can be glued just the way it comes from the saw

11 Handy for use in bathroom and kitchen, the Tenite II sink strainer, drinking glass and funnels are molded by Vichek Tool Co. The use of cellulose acetate butyrate rather than metal and glass banishes from the housewife's mind worries about rust or breakage. And the bright red of these pieces adds a cheerful note to any room

12 It's a new housing of wood flour filled phenolic for portable testing meters. Molded in three parts by General Electric Co., the textolite case has been found both less expensive to produce and lighter to carry than those formerly made of mahogany. The molding cycle for two of the parts is 3 to 4 min. and for the third, 5 to 6 minutes

13 These powder and paint brushes are made for the meticulous woman who applies cosmetics with precision and care. The face brush, a product of Merle Norman Cosmetics, consists of a hollow body molded of red cellulose acetate and a transparent acetate tip which are cemented together in a final finishing operation. The bristles are of camel's hair and are glued to the inside of the assembled brush. The Holly-Vogue lip brush is produced in an 8-cavity die for Lasdell Products. In this case the bristles are of nylon or horsehair which are pressed into the end of the body in a metal or plastic barrel. Both face and lip brush are molded by Plastic Die and Tool Corp.

14 If parts don't fit together tightly when an aircraft is assembled, these little thermoplastic wedges can be inserted to take up the slack. Injection molded by Northern Industrial Chemi-

PLASTICS IN REVIEW

cal Co. for Grumman Aircraft Engineering Corp., the wedges are of Lumarith. This particular plastic material was selected because it has a certain amount of given flexibility

15 Designed by Freda Diamond, this table has a wooden top and Lucite legs which are preform-molded by World Wide Wood Industries. One of a series of modern designs, the table can serve as an end table, an occasional piece or a cocktail table. Future plans call for the oak top to be replaced with one of enamel which will be available in a number of colors. T. Baumritter Co. is the distributor of these smart wood and methyl methacrylate tables

16 Maintenance records speak well for laminated washers cut from sheets of Compar which have been pressed into service as aligning rings for the assembly of metal tube bases for radios. Constantly exposed to abrasion during radio assembly jobs, the rings must be cut from sheet stock formulated to specified durometer hardness and resiliency. At least one manufacturer rates the performance of the long wearing synthetic rings head and shoulders above that of the molded gum rubber rings which were used previously

17 For the man behind the bar, Aard Co. molds these Styron jiggers. They are welcomed items, too, because they're break- and chip-proof, will not be affected by alcohol and come in a variety of shapes, sizes and colors

18 Dangerous liquids and those producing unpleasant stains are kept away from the feet and ankles of industrial workers by Sureseal spats or leggings developed by Surety Rubber Company. The protectors are made of a silver-colored material formed from a lightweight, closely woven cloth impregnated and coated with Neoprene. This fabric is said to defy acids, caustics, solvents, oils, fats and greases. Cut particularly full, the spats and leggings reach all the way to the floor covering the front of the shoe completely

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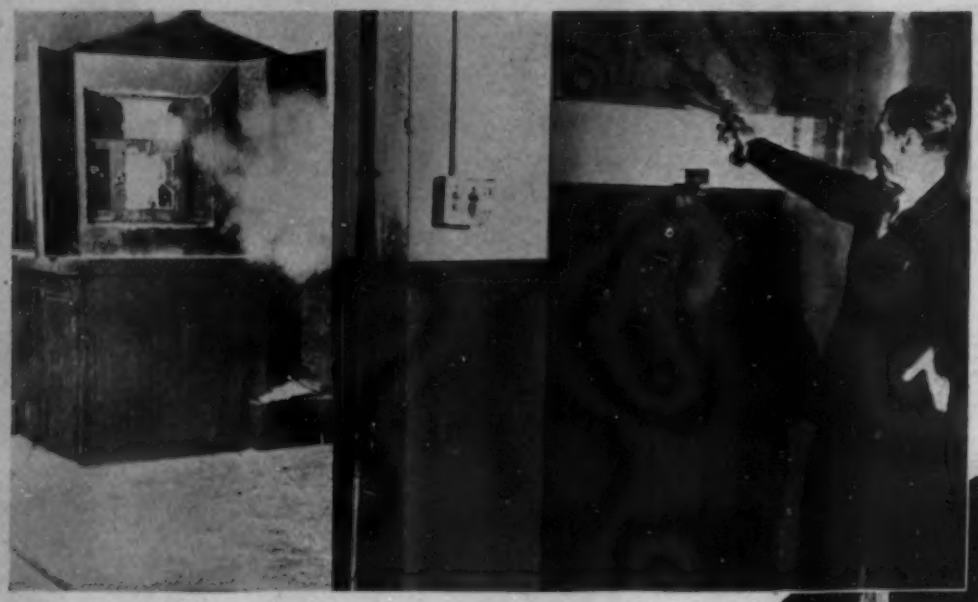
Tests of "under fire" production



Left. Three shots are fired from a 15-ft. range to test bullet resisting glass. Below. Glass is examined after testing. It must not throw off slivers or be pierced. Plastic laminations help prevent shattering

Insulating wiring, bullet-resisting glass, fire extinguishing equipment and like products are subjected to the most severe conditions of use. For this reason, manufactures of this type of equipment make a practice of submitting their products to the National Board of Fire Underwriters. In the laboratories of this non-profit institution the products, and the materials that go into their construction, are tested as to their resistance to conditions under which they must function

WHAT is the score for plastics in relation to the hazards of fire, casualty and crime in tests of "under fire" performance?

The answer to such a question is not nearly as difficult to learn as might be supposed. It is only necessary, in fact, to survey the activities of an organization that in the last half century has examined, approved and labeled according to its standards more than 250,000 products of some 5000 manufacturers. That organization is Underwriters' Laboratories, Inc., a non-profit institution sponsored by the National Board of Fire Underwriters. Tests carried on in these laboratories are perhaps the most complete and impartial on record.

Insulated wiring—the largest field involving plastics

Take, for example, the field of insulated wire, the largest now engaging the attention of Underwriters' Laboratories so far as the use of plastics or synthetics is concerned.

Of all products, regardless of the material from which they are made, an average of 50 percent are rejected by Underwriters' Laboratories on their original tests. In thermoplastic insulated building wire, however, the comparable percentage of rejects is only 10 percent. This is holding true in spite of the fact that more and more wire with plastic insulation is being submitted each year, the number of separate types now running well into the hundreds. In 1939, only one-fourth of one percent of all the building wire accepted and labeled by Underwriters' had synthetic insulation; today, the figure is 10 percent or more.

Insulated wire, of course, is only one of the countless classes of products involving the use of plastics that are examined in the three big laboratories of the organization in Chicago, New York and San Francisco. The others range all the way from electrical parts and appliances of many kinds to plastic paddles in sprinkler system flow alarms, and from fire-retardant plywoods, impregnated woods and similar materials to bullet-proof glass and even to a "heater" to keep refrigerator doors from freezing. The last mentioned device, necessary because the center pillar between double doors on a refrigerator was too narrow to permit proper insulation, consisted of a length of michrome wire enclosed in a plastic tubing. The refrigerator was approved to carry the Underwriters' inspection label.

Entirely apart from the fact that wiring is the largest "plastic" classification coming under laboratory scrutiny, insulated wire affords an excellent example of the current work of the institute in products involving the use of synthetics. For one thing, the field is rapidly expanding to include flexible cords used in home appliances. Many of these have thermoplastic insulation and have been approved and labeled by Underwriters'. Along with these cords, Underwriters' has tested and approved attachment plug caps made of such thermoplastics as plasticized vinyl resins and polystyrene in addition to thermosetting materials. So far the

Laboratories have had little field experience with the polystyrene caps because of scarcity of that plastic.

Another reason why synthetic insulated wires have assumed more than ordinary current importance is that the Underwriters' tests have shown that they are by no means emergency substitutes for insulated wire. Among the numerous advantages they enjoy over either crude or reclaimed rubber is resistance to certain oils, acids and chemicals not possessed by rubber and oxidation. Little change in structure occurs as time passes, and they have satisfactory aging qualities under sunlight.

A new standard for thermoplastic insulated wiring

A final reason for stressing insulated wire over other products tested by this institute is that a new Standard for thermoplastic insulated wires has been issued by the organization and a résumé of these standards gives a good insight into the methods and procedures of Underwriters' in its testing and labeling activities.

In discussing these methods and procedures, it must be remembered that all products tested by the laboratories are examined as a whole and from the standpoint of their intended end use. The various insulated wires, for example, were submitted by the wire manufacturers and not by the companies making the plastic material for the insulation, even though the insulation was the focal point of the investigations.

It is noteworthy, too, that in issuing the new wire standards the institute used the term, "thermoplastic-insulated," instead of "synthetic insulated," because it was decided "thermoplastic" has a more definite and understandable meaning.

Requirements for thermoplastic-insulated wire, as set forth in the new standards, are numerous and broad in scope. Sizes, number of strands, resistance, joints, etc., in the conductor itself are regulated—most of them in accordance with carefully worked out standards and tables. Then, for the insulation itself, the standards include thickness, physical properties, flexibility and deformation.

Insulation in Awg sizes 1–0000 wire must be at least $^{5}/_{64}$ in. in thickness. It ranges down to at least $^{3}/_{64}$ in. for sizes 14–9 with a minus tolerance of 10 percent for insulation $^{4}/_{64}$ in. or more in thickness. Other tolerances are set forth in a description of how thicknesses are determined. For example, "for insulation nominally less than $^{3}/_{64}$ in. in thickness, the minimum thickness is to be determined by means of a pin-gage micrometer; and the minimum acceptable values for $^{3}/_{64}$ in. insulation (at the thinnest point) is 0.028 inch."

Requirements for physical properties, before and after aging, are set forth in tables. The same is true of flexibility. Thickness of the insulation, according to the requirements, "shall not decrease more than 50 percent when subjected to a temperature of 120–122° C.," under the test pressure.

Building wire is aged for 60 days at 70 ° C., to see that the insulation does not become stiff, hard or brittle and to insure its conformity to the 60° C. requirement of the National Electrical Code. Switchboard wire is tested for 60 days at 87° C. to make sure it is good for the 80° C. requirement.

When tested for use in chemical reagents, wire is actually immersed in the acid or alkali solution for a year and tested electrically during that period.

Flame-retardant properties of thermoplastic insulation must be "such that the wire will not convey flame, nor continue to burn for more than 1 min. after five 15-sec. applications of a standard test flame. The period between applications of such flame is 15 seconds." Finish, dielectric strength, insulation resistance and other qualities are standardized. Manufacturers are then required, on all approved wire bearing the Underwriters' label, to mark or tag each coil or reel with the maximum working voltage for which the wire is intended. The manufacturer's name and/or trade name, date of manufacture by month and year, proper type designation (T or TW), Awg size, the manufacturer's identifying marker for thermoplastic insulation and with the words, "National Electrical Code Standard."

All told, of course, countless different types of wire are tested, always in relation to the intended use. Recently, for

Calibration tests are made on light fuzes to learn how rapidly they blow on an overcharge of current. These fuzes utilize cold-molded plastic cases, and cellulose acetate windows are used to replace mica

ALL PHOTOS, COURTESY OF UNDERWRITERS' LABORATORIES, INC.

Thermoplastic and synthetic rubber insulations on building wires are age tested in this air-oven. The tensile strength after aging must be at least 75 percent of unaged wires

The thickness of the thermoplastic insulating tube, which protects the copper conductor, is gaged on a sensitive micrometer which measures to the half thousands of an inch. Several readings are taken to get a final reading

instance, the laboratories approved a wire for use in appliances which would withstand voltages up to 1000 and temperatures up to 90° C. but would not be subjected to much abrasion. A combination insulation was used. It consisted of several layers of cellulose acetate butyrate tape next to the conductor, then a layer of felted asbestos, and an outside layer of lacquered glass braid.

The tools for testing

Some 13 years were required to develop the equipment now used by the institute to test the fire-hazard qualities of various building and other materials. With this equipment it is possible, for the first time, to thoroughly test larger pieces and sections of these materials and thus obtain a better picture of their efficiency. It now is being used to determine the fire hazard characteristics of various building materials employing plastics.

Bullet-proof glass

Tests of bullet-proof glass have been among the most interesting and spectacular activities in these Laboratories. One such test involves the firing of three shots from a 0.357 Magnum pistol made by Smith and Wesson, said to be the highest powered hand weapon available today, from a range of 15 feet. The bullets must not pierce the glass or throw off slivers or other glass particles from the reverse side of the glass. This latter requirement is to safeguard the eyesight of the driver of an armored car or the bank teller in his cage.

Some of the tests of bullet-proof (Underwriters' engineers prefer to call it bullet-resisting) glass have involved glass with laminations of cellulose nitrate, but most of it has had laminations of cellulose acetate, polyvinyl butyral or other types. One of the requirements is that the laminations do not discolor with age or show other signs that their stability is affected.

A hand-type fire extinguisher

The facilities of the Laboratories were used in the search for and testing of substitutes for materials that were critical, especially early in the war. One of the most interesting cases was in connection with the OCD's hand-type fire extinguisher of which 2,258,000 were ordered by the OCD for the use of air raid fire wardens, and another 100,000 of a similar type by the Army.

As finally developed, the extinguisher employed plastics in the piston, piston rings, stuffing box, valves and nozzle. A 10-ft. hose used reclaimed rubber. During the period of experimentation, numerous types of plastics were tried for the hose. Some of them proved satisfactory, only to be placed on the critical or essential list shortly after the tests and thus placed "out of bounds" as far as availability was concerned. After approving the design for each manufacturer, it was Underwriters' job to establish procedures at various factories for testing the production and labeling the units.

Comparative burning tests

To obtain information on the combustibility of commonly used plastics, Underwriters' made a series of comparative burning tests of twelve types of synthetic materials, the results being widely used in subsequent investigations and examinations of plastic products.

Eleven of the plastics were obtained in the form of slabs or sheets of various thicknesses. Cellulose acetate samples represented the range of compositions produced by two manufacturers. Three samples of phenolic molding materials, one having cotton filler, one wood filler and the third asbestos filler, were used. Six vinyl-chloride vinyl-acetate copolymers represented the range in both plasticized and unplasticized types. There was a sample of cast phenolic and another of coumarone-indene resin. This latter sample was obtained in the form of pellets and because of this fact was not placed in any one of the three groups outlined later. The method of testing was confined to spreading the pellets on a wire screen and igniting them with a $^3/_4$-in. test flame.

In describing the methods of test, Underwriters' said:

"Where the size of the samples permitted, specimens in the form of bars, $^1/_4$ by $^1/_4$ by 6 in. were prepared. In the case of the samples having a thickness less than $^1/_4$ in., two speci-

mens were prepared, one having a width of 1/4 in., and the other having a width such that the cross section area of the specimen was 1/16 sq. in. This was done so that burning times of equal volumes could be obtained.

"The test flame used as a source of ignition was a 3/4-in. high luminous (yellow) gas flame." (Here it was explained that the dimensions of the test flame were approximately the same as those of the flame of the common strike-on-the-box match.)

"The test specimens were hung vertically in an enclosure designed to prevent drafts, and the test flame applied to the lower end of the specimen. The duration of application of the test flame, the length of time that the specimen burned, and the height of flame were recorded in each case. Any afterglow also was noted."

After the tests were made, the various plastics were classified in three groups as follows:

Group 1—In this group was placed the materials that burned at about the same rate as cellulose acetate (classified as "slow-burning"): acrylic, polystyrene, cellulose acetate butyrate, and one sample of polyvinyl alcohol, in addition to the cellulose acetates used as the basis of comparison.

Group 2—This group included materials burning with a feeble flame which may or may not propagate away from the point of ignition: casein, urea-formaldehyde, three samples of phenol-formaldehyde, and one sample of the vinyl-chloride vinyl-acetate copolymers.

Group 3—Materials burning only during the application of the test flame were placed in this group: cold molded, plasticized polyvinyl chloride, two samples of plasticized vinyl-chloride vinyl-acetate copolymer, three samples of unplasticized vinyl-chloride vinyl-acetate copolymer, asbestos-filled molded phenol-formaldehyde, and one sample of plasticized polyvinyl alcohol.

After the results of the tests were announced, the institute's statement explained:

"It must be borne in mind that the relative combustibility of any particular plastic composition depends not only on the synthetic resin used but also on the plasticizers, fillers and pigments incorporated in it. As was shown by the difference in behavior of the two polyvinyl alcohol samples, the plasticizer used with the synthetic resin in the manufacture of the plastic may have a profound effect on the relative combustibility of the finished product. The effect of the filler is well illustrated by the results obtained on the three samples of molded phenolic material, containing cotton, wood and asbestos fillers, respectively. Because of these facts, an individual composition of a particular type of plastic may fall into a different group from the samples of the same type of plastic used in these tests."

It also was explained that cellulose nitrate, "among whose hazardous properties is that of exothermic decomposition, would fall into a group more hazardous than those outlined above."

Plastic products investigated by Underwriters' Laboratories are tested in a manner comparable to tests of products made of other materials. The institute's label does not mean that the organization recommends that particular product over another; only that the product has been examined, inspected and approved from the standpoint of fire, casualty or crime hazard in the use to which it will be put.

Underwriters' tests begin when the product is originally submitted, and continue after the product is put into production. They are made at regular intervals making sure output is being maintained at a level that is uniform with the first sample. Often, as has been the case with products using plastic materials, the first laboratory submittal does not meet requirements. In such cases the article is redesigned and resubmitted until it is in a form that is satisfactory. Frequently, too, a plastics concern, developing a part or material for another product, will arrange with the maker of that product to submit it to the institute for testing and approval so that the plastic application will receive thorough attention as part of the entire job.

To determine their fire hazard classification, all plastic building materials are placed in this oven. Gas flames are projected against one end of the material and the progress of the fire is then studied

Jungle machete knife

A machete knife which folds conveniently into its cellulose acetate butyrate handle is honorably discharged from its wartime duties to a new civilian role as a mainstay for hunters and woodsmen

MENTION something new in hunting knives to the hunting enthusiast or to the avid woodsman and he is immediately your friend. He knows only too well how highly essential a good knife is to his hunting enjoyment and sometimes even to his survival when he is on his own, far from civilization. He has tried every variety of knife which has already appeared on the market and is well aware of their advantages and also of their limitations. If you tell him, then, that you know of a hunting knife which has all the effectiveness of the wartime machete yet will fold conveniently into a durable black cellulose acetate handle to facilitate carrying, and can be put into action almost on the instant, you can be certain you will have his undivided attention.

The hunting knife in this case is a peacetime adaptation of the machete which was used with such deadly accuracy by our Armed Forces stationed in the thickly wooded jungle areas of the Southwest Pacific islands. These machetes, approved by the Army Air Forces after a number of exhaustive tests conducted at Wright Field, consist of three principal parts: a forged steel razor-sharp blade, measuring 10 in. in length and 2 in. in width at the widest point, that can cut down a sapling with a single stroke or a 4-in. tree with little difficulty; a handle assembly, injection molded by Cruver Manufacturing Co. of black Tenite II; and a combination metal guard and clamp, 6 in. long. When ready for use, the implement is approximately 16½ in. long; when folded, it measures no longer than the length of the knife blade. Assembly of the entire knife unit is effected at the plant of the molder.

The handle assembly consists of two cellulose acetate butyrate faces, each ⅝ to ½ in. thick, two steel inserts and a keeper spring plate in the center which has spring action at both ends, for both the blade and the guard. These parts are riveted together, making the handle slightly more than 1 in. thick, 6⅝ in. long and about 1¾ in. wide. In design the handle is of the firm grip type, being rounded at the ends.

Operation of the knife is essentially simple. When it is acting as a clamp, the guard fits into the knife handle, thus holding the blade firmly in the open position. A lock slide is also provided for use when the guard is closed. The keeper spring plate in the center of the handle assembly serves a double purpose: the spring at the blade end acts as a shock absorber for heavy blows of the knife, and the spring at the guard end provides tension when the guard is closed. When the knife itself is to be closed, the guard opens out and, together with the handle, forms a channel into which the sharp side of the blade fits with ease.

Heavy enough to give force to blows when wielded by the user in cutting through dense jungles, or to swing effectively in hand-to-hand combat with an enemy, yet light enough to be handled with ease, the machete successfully survived a production test of one thousand strokes against wood before being put into general use. It was designed for members of the Army Air Forces complete with an attractive leather holster containing a sharpening stone for the blade which was set in the flap. In the case of holsters which are designed to strap on the leg of the combatant, two straps were provided for this purpose.

Since the prime purpose of both the machete and the hunting knife is the same—the quick and effective elimination of the heavy undergrowth which makes progress difficult both in woods and jungles—the adaptation in this particular postwar application of a tried and workable wartime development is relatively slight. The folding hunting knives are still the combination of ingenious design and an easy-working assembly (the exclusive design of the molder) which made their prototype—the machete—such an accurate weapon.

Proximity fuze taught new techniques

by CHARLES KLEIDERER*

THE proximity fuze, better known as Project A to scores of operators in the plastics industry, foiled the enemy at many crucial points in the global war just completed. It forced the Germans to abandon use of the V-1 or buzz-bomb over England. Secretary of the Navy James Forrestal declared that the proximity fuze was instrumental in speeding up the Navy's westward drive and General Patton wrote that the new shell with the funny fuze would force armies to devise a new method of warfare.

Navy officials ranked it next to the atomic bomb as the most successful scientific development of the war. In fact this same fuze, minus the battery, was used to set off the atomic bomb. But without the wholehearted cooperation of the plastics industry there could have been no fuze of this kind. Not only was the fuze housed in plastics materials, but some of its most important inner components were formed from plastics and protected by plastics formulations.

At the end of the war more plastics raw materials were being allocated for this particular item than for any other—something like 1,000,000 lb. a month. Between 160 and 170 molders, laminators, fabricators and raw materials producers had taken part in the program. More than 8,300,000 fuzes were produced in 1944 with a constantly accelerated program under way. The cost had been reduced from $40 to $18 per fuze. Production and research costs were estimated in excess of $800,000,000 and 80,000 workers were employed on the job, scarcely any of them aware of what the end product was.

It is difficult for a war-worn populace to look back upon past achievements with much enthusiasm. Today the public wants to know "what's next?" Except for a paper weight, what good is a shell fuze in an office—what function can it perform in an automobile or a refrigerator or anywhere else where plastics are applicable?

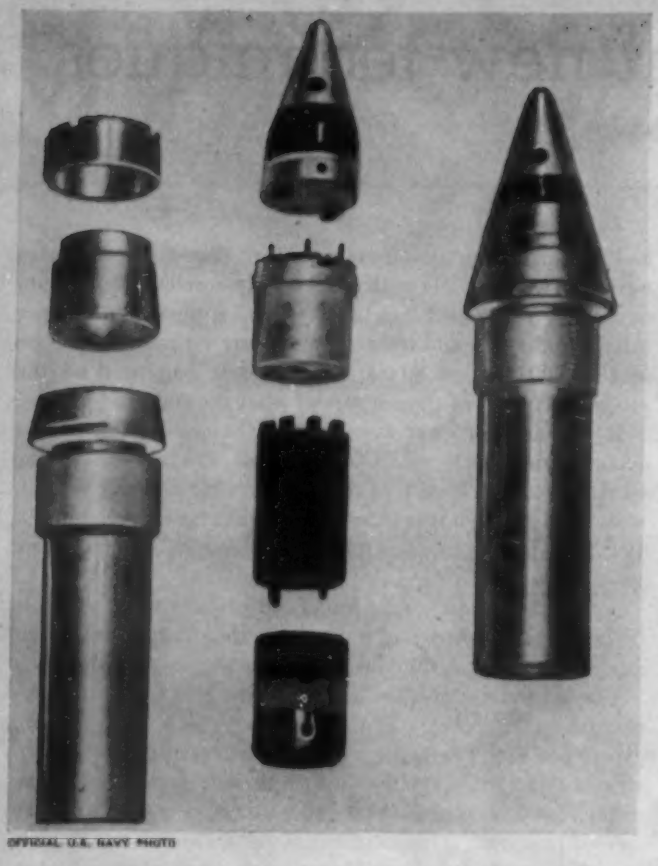
So, for the moment, let's forget our pride in helping to win the war and ask ourselves if we can learn anything from that experience which will help to keep our presses operating.

The answer is, or should be obvious to those who have worked on Project A. In the first place, as a result of their experience with Project A, molders have learned that a tolerance of 0.002 in. is attainable with plastics materials. Heretofore, 0.005 in. was unusual and 0.010 in. was generally considered passable. This tolerance is still far below metal working where 0.002 in. is possible for machining precision instruments but, in metal working, such tolerances are seldom ob-

* Plastic Development and Production Engineer for Project A, Johns Hopkins University, Silver Springs, Md.

OFFICIAL U.S. NAVY PHOTO

1—The cutaway drawing shows a complete proximity fuze assembly. The way in which the plastic nose is molded to the steel base and screwed into the metallic cylinder is clearly evident. The metal cylinder contains the battery, safety devices and also the auxiliary detonator



OFFICIAL U.S. NAVY PHOTO

2—*The disassembled metal housing (left) is of a very early model of the proximity fuze. In the center lineup of parts, which were used for a later model, the ethyl cellulose housing (top) contains the antenna, tubes, oscillator and polystyrene coil form seated in an ethyl cellulose base. Positioned below this housing in the photograph is the amplifier containing more tubes. This section was removed in later models and these same electrical units placed in the front case which was made longer. Still in the center lineup but below the amplifier is the battery. The bottom segment is the rear fitting or detonator. When fitted together all these parts go to make up the complete fuze shown at the right*

tained or even necessary. The 0.002-in. tolerance for plastics is, therefore, a milestone in progress.

Second, molders have learned how to handle, on a practical basis, two rather new molding powders, ethyl cellulose and vinyl, which were sometimes avoided in earlier years because of their supposed difficulty in handling.

Third, a new wet battery has been developed in which plastics play an important part and for which there should be many new uses.

Fourth, old formulations have been improved, to the extent that certain characteristics such as toughness, impact strength, heat resistance and electrical insulation properties have been improved.

Fifth, a new potting compound which can be used as a paste, a filler or a protective sealant has been discovered.

Before going into these developments it is necessary to give a detailed description of the fuze and to point out the requirements and reasons for various necessary production operations.

The variable time (VT) or proximity fuze was employed principally in the 5-in. gun, the primary naval long-range anti-aircraft weapon. Its average effectiveness is from 300 to 400 percent greater than that of time-fuzed projectiles. This means that the equivalent of three or four times as many guns bear on the target.

During the year 1943, 75 percent of the rounds fired by naval 5-in. guns were time-fuzed projectiles, and 25 percent were VT fuzed. Of the airplanes shot down during this period, 49 percent were credited to time fuzes, and 51 percent to VT fuzes. These figures establish an advantage ratio of 3:1 for VT fuzes. Improvements since that time have increased this advantage ratio.

The VT-fuzed projectile's margin of combat advantage over a contact fuze is even greater than over a time fuze. Since contact-fuze shells must actually strike the airplane to detonate, the lethal burst area of a 40-mm. projectile for an approaching airplane is quite small—about 60 sq. ft. The average lethal burst area of a VT fuze 5-in. projectile is much larger for the same airplane—about 3000 sq. ft.—since the shell will be detonated if it passes within a radius of 75 to 100 ft. of the plane. In other words the airplane, as a vulnerable target, looks about 50 times as large to a VT-fuzed projectile as it does to a 40-mm. shell.

Combat use on land also established the devastating effect of air burst on light equipment, and especially on personnel not under adequate cover. The Germans were panicked at the Battle of the Bulge because VT fuzes were employed against rear echelons who had little or no cover, and shell fragments rained down on them with deadly effect.

The early models

The fuze is made in several models of different sizes and will fit various caliber shells from a 3-in. up to an 8-in. or even a 240-mm. howitzer. It is essentially a "5-tube" radio sending and receiving station with glass tubes that measure no more than an inch in length and $^3/_8$ in. in diameter yet are rugged enough to withstand the shock of being fired from heavy cannon. The detonation of the projectile is accomplished by an electrical detonator much like a dynamite cap. When the thyratron is triggered by the impulse generated by the shell's approach to a target, it causes enough electric current to pass through the electrical detonator to make it explode. This explosion sets off an auxiliary explosive charge, or booster, carried in the fuze, which in turn detonates the explosive filling in the projectile.

In addition to the primary elements of the fuze, there are safety devices which prevent operation of the fuze until it has traveled a safe distance beyond the muzzle of the gun.

The fuze in production at the end of the war was housed in an ethyl cellulose fuze case molded to a steel, brass or aluminum insert with rubber cement at the base for waterproofing (Figs. 1 and 3). The ethyl cellulose was supplied by Dow Chemical Co. and Celanese Corp. of America whose material is based on Hercules flake. Green, red, amber or blue plastic was used, depending on the model. The case contains an antenna, oscillator and amplifier. The tubes are held in neoprene molded in the form of rubber socks. In addition to the housing there is a $^3/_4$-in. long by $^1/_2$-in. in diameter polystyrene coil form seated in an ethyl cellulose base. All these parts are sealed by pouring hot microcrystalline wax around them, and the entire fuze is closed with a terminal wafer molded from high impact phenolic. The battery is housed in a metal case attached to the base of the fuze.

The original models comprised an aluminum cap, which served as an antenna, and a housing machined from methyl methacrylate rods. But the process of machining the rods was too slow—there were not enough facilities in the country

to do the job on the large-scale production contemplated. A number of small holes from 2 to 2½ in. long were required and many other complications slowed up operations. In addition, preheating of the fuze for the application of hot wax and the use of a flame to remove excess wax after the fuze was sealed, sometimes caused distortion. In later models a methyl methacrylate molding compound—Lucite (HM-119)—was developed that proved suitable. But by that time a satisfactory ethyl cellulose housing had been worked out and approved. Furthermore, methyl methacrylate was becoming increasingly difficult to obtain because it was needed for the expansion in the airplane program. However, more than one third of all the VT fuzes produced were housed in methyl methacrylate.

Nearly all possible plastics raw materials were tried for this fuze housing before production was finally frozen to ethyl cellulose. Additional production facilities were immediately authorized. During the final period of the war almost 500,000 lb. of this material was allocated monthly for the VT fuze. It was chosen primarily because of its toughness, high impact strength over a wide temperature range, specific electrical properties and lower heat distortion point compared with other materials that were tried. Other plastics also had these same characteristics but not in the same combination as ethyl cellulose. The first samples of ethyl cellulose were severely distorted in the process of preheating for the wax treatment but the producers steadily improved their formulations of this material until they came up with a compound that met the requirements.

Another tough temperature requirement was resistance to the heat generated in the muzzle of a cannon while the shell is passing through after it is fired. In this case even the special ethyl cellulose formulation comes out of the muzzle looking like knurled steel.

The lessons learned

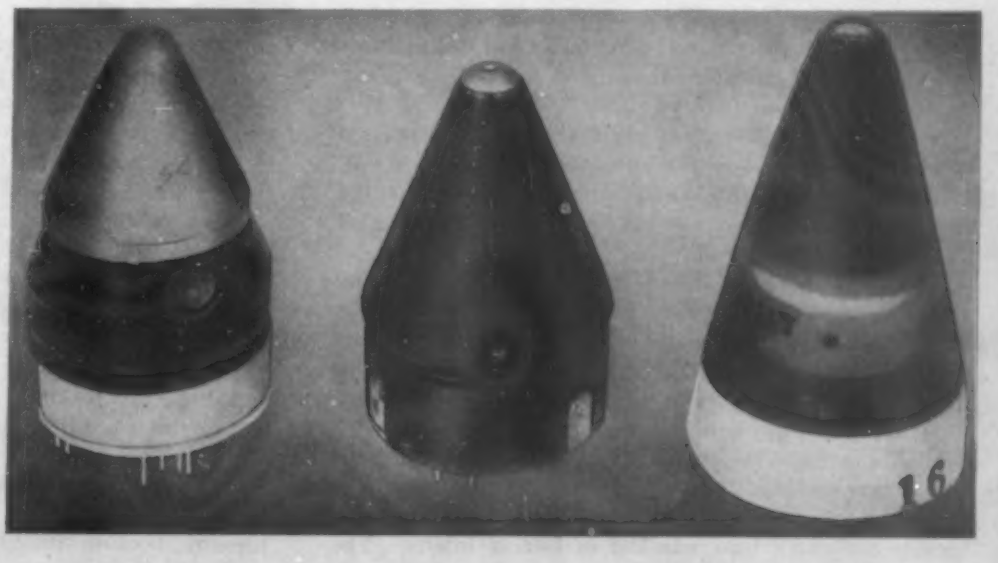
When it was decided that a sufficient quantity of fuzes could not be produced by the machining process, the next problem was to find molders who could and would injection mold an ethyl cellulose item that required a plus or minus 0.002-in. tolerance. The basic lesson learned from experiences in molding both ethyl cellulose for the fuze and vinyl for the battery was that fine tolerances could be obtained only by constant attention to detail. Molders learned that temperatures and pressure must be uniformly stable at all times and that dies must be worked over time and time again until they were accurate to the tiniest detail. In the case of ethyl cellulose it was definitely ascertained that best results were attained with the highest possible temperature and the lowest possible pressure.

One of the first difficulties to be overcome was eliminating moisture from ethyl cellulose molding powder, a factor which was responsible for surface defect. Most molders dried it in an oven with infrared lights. It was spread at a depth of no more than ½ to ¾ in. and raked every 15 min. to prevent gumming. This process might take anywhere from 2 to 6 hours. As an additional precaution, the powder was generally stored in steam-dried rooms. Molders also discovered that the use of infrared lights on hoppers helped dispel the moisture problem for ethyl cellulose and all other raw materials.

Care also had to be taken to ensure complete filling of the die. The problem of obtaining a good fit around the threaded insert was particularly serious since ethyl cellulose will shrink as much as 0.006 in. per in. after molding. It was found that this shrinkage problem could be overcome by: 1) carefully watching the temperature to prevent extremes, particularly low extremes; 2) maintaining a uniform pressure and 3) heating the inserts.

Regulation of the molding temperature was of paramount importance. In the early days each batch of material was slightly different and, consequently, molding temperatures had to be varied. Producers soon remedied that defect by blending, and uniform shipments were the rule after the importance of such treatment was demonstrated.

The best molding temperature varied according to circumstances, particularly as to type of machine. In some cases the molding powder was almost burning when it came out of the nozzle. But the temperature of the material would then be dropped suddenly as much as 10 or 15 degrees. The temperature range varied from 475 to 550° F. according to the machine. In addition the molders consistently used a warm mold, heated to 110 to 150° F., and generally warmed the inserts. This entire process naturally increased the time of the molding cycle although molders had improved their technique so thoroughly that by the end of the war the cycle for the small model had been reduced to 70 sec. per shot in comparison to a 15-min. cycle in the early development period. It was also found that impact strength of the finished item could sometimes be increased as much as 1 or 2 ft-lb. by increasing the molding temperature. (*Please turn to next page*)



3—These three models show the evolution of the proximity fuze. The fuze (left) is made up of an aluminum cap, which served as an antenna in early models, attached to an acrylic housing fabricated from 2½ in. diameter rod stock. The center piece shows a nose injection molded of acrylic and a metal base. The part at the right is the final model which was molded from ethyl cellulose with an inner metal wire serving as an antenna

4—Reading from left to right, the battery, which is shown assembled below, consists of the phenolic top sealed with a potting compound, the assembled battery plates which are encased in a wall of vinyl resin, the elastomeric vinyl thimble or container for the glass liquid-carrying ampule and the breaker

Pressure was kept as low as possible—to approximately 1000 lb., depending on the type of machine. The only way to determine the proper pressure and temperature was by trial and error. Some molders made as many as 500 pieces and put in several days of experimentation before they were ready to move into actual production. It was not unusual to find that no part of the first few pieces met dimensional specifications, but molders were cautioned never to change a die until they were sure the machine was thoroughly regulated. Bubbles, blisters, excessive well lines and laminations showed up quickly if there was the slightest error in the pressure or the temperature (generally too low) but their very presence nearly always indicated the trouble spot.

Tooling up

Die makers, especially those who had never made dies for plastics, gained considerable experience in working out problems from this project. One of the first things they had to learn was that chrome steel must be used in this industry and that compensation for shrinkage in a mold is a vitally important factor.

It was sometimes difficult to impress upon them that ethyl cellulose shrinks 0.006 in. per in. so that when an object of, say, 3 in. is to be molded, the shrinkage will be 0.018 and the discrepancy must be compensated for by adding or taking off the proper space on the die.

Die makers who had already had experience in working with dies for plastics, were not particularly bothered by the shrinkage problem though never before had they been required to meet such rigid tolerance requirements. In most cases the final adjustments had to be made after a test run and corrections made by plating or grinding the die.

All dies were hobbed and contained from one to eight cavities. There was one 10-cavity die for a 22-oz. machine, but operations on large machines were not particularly desirable because too much time was lost in loading inserts. The optimum production was achieved by using 4- to 6-cavity molds on from 8- to 16-oz. injection machines.

There was one model fuze much larger than the others which is reported to be the deepest drawn mold ever made for plastics. It was 16 in. long with a base diameter of 5 in. tapering to a round nose. It was end gated in comparison to the smaller models which were gated on the side. The end-gated unit weighed approximately 8 oz. whereas the smaller side-gated nose contained 2 oz. of ethyl cellulose molded material. End gating was helpful in avoiding excessive well marks and resulted in a stronger finished piece. End gating was of no advantage in the small fuze because the mold was filled in much shorter time.

Vinyl in the VT fuze battery

The experience gained in working with ethyl cellulose is similar in many ways to that gained by those who worked with molded vinyl. The nose of the fuze contained no vinyl but the "gadget" which furnished the electric power to make it work was a small battery containing numerous parts molded from vinyl and other plastics materials. The battery was encased in a metal housing attached to the base of the fuze. It is about $2^1/_2$ in. long and $1^1/_9$ in. in diameter. The $^1/_8$-in. walls are molded of one of the following three materials: elastomeric vinyl, rigid vinyl, or Cliderite, a thermal potting ethyl cellulose compound.

The first battery used was dry cell, but its shelf life under South Pacific conditions was sometimes limited to as little as three months. This deterioration required an extensive program of battery replacement. After a long period of research a method was found to eliminate the dry battery mix and substitute a suitable electrolyte stored in a glass container, or ampule, as an integral part of the battery. The battery would become active only at the moment of use when the shock of gun fire would shatter the ampule. Retention of the electrolyte apart from the other active ingredients has resulted in a power source exhibiting indefinite life. Production of this revolutionary type of battery began in January 1943.

There are 63 plates separated by insulated laminated paper contained within the walls of this unique battery. These plates, which are fashioned from zinc and carbon, are round disks with a hole in the center. When assembled, they are covered or coated by injection molding vinyl resin or the potting compound over them. The tolerance is 0.003 inch. The temperature for molding rigid vinyl was 310° F.; for elastomeric vinyl it was 320° F. and for the potting compound it was 325° F. Molding pressure on the cylinder for rigid vinyl was 400 lb.; for elastomeric vinyl, 400 lb.; and for the potting compound, 15 pounds. The last material required little pressure because its high (*Please turn to page 206*)

PLASTICS*
Engineering Section
F. B. STANLEY, Editor

Weave as it affects glass cloth laminates

by FRED J. MEYER and ERVEN WHITE†

In glass fabric laminates, the highest strengths are to be obtained from the thinnest cloths. This is the conclusion drawn from a series of tests carried out on plain-woven glass fabrics. Additional tests are being made on unidirectional cloths, satin weave fabrics and several glass mat products

DURING the past year, new facts relating to properties and improved fabricating techniques, coupled with military requirements, have resulted in tremendously increased production of Fiberglas-reinforced laminated aircraft parts and equipment. Of special significance has been a realization of the dependence of the properties of finished laminated parts on the type and construction of the glass fiber fabric used. Both fabricating experience and research investigation have proved that the various strength properties which distinguish glass fiber laminates from those made with other materials are affected in various degrees by variations in fabric construction.

The first public revelation of the properties of glass fabric reinforced low-pressure laminates was made in May 1944.[1] This discussion was based on data developed from research conducted for the Aircraft Laboratory, Engineering Div., U. S. Army Air Force Materiel Command, Wright Field. The objective of this research was to determine maximum attainable strength properties and to establish design data for aircraft structural parts. Consequently, it was largely centered around the fabric constructions that would produce optimum values.

The strength values reported at that time were obtained on laminates made from unidirectional cloth (OC-64) with the plies crossed so that each ply had its direction of greatest strength at 90° to the greatest strength of the immediately adjacent plies. A few data on laminates made from a thin, plain-woven fabric (ECC-112) were also reported. It was shown that either of these fabric constructions could be used to produce laminates having a combination of properties that made them superior on a weight-strength basis to any other known materials for aircraft structural applications.

As fabricators extended the use of glass fabric for laminated sheets and shaped parts, they very quickly found that reduced fabrication costs resulted from the use of thick, plain-woven fabrics that did not require cross lamination. Consequently, they have used large quantities of plain-woven fabrics, and the unidirectional fabrics have been used only in a few specialized applications.

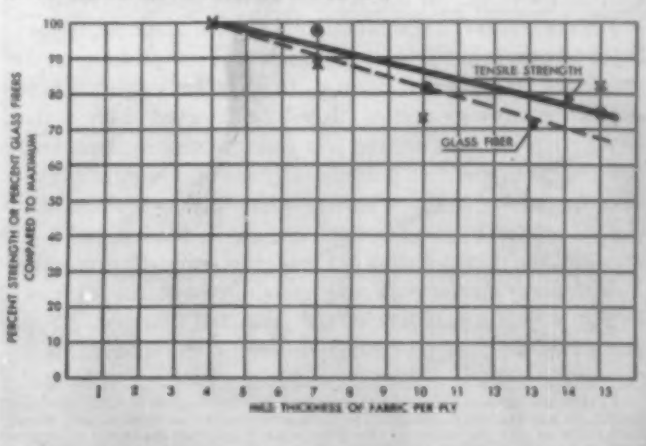
The strength properties of commercial laminates made by different laminators using a wide range of fabric thicknesses and construction have often been low in comparison to the strengths reported to the Aircraft Laboratory. However, the significant values of dimensional stability, low moisture absorption, stable electrical properties, high impact strength, and above-average general strength properties have constantly been maintained wherever good laminating practice was followed. As a result, the plain-woven fabrics have been used in applications where exceptionally high strength-weight ratio was not the primary requisite. Fuel cell backer sheets and radar housings illustrate such usage.

Although research is still incomplete and many facts are yet to be obtained or more fully confirmed, it is quite evident that there is a wide variation in the strength properties of low-pressure laminates made with different weaves and thicknesses of glass cloth. For these reasons alone, it is impossible to predict all the properties of a finished laminate by any simple calculation based on the properties of reinforcing fabrics. Further variables are introduced by the type of resin used and by the curing conditions.

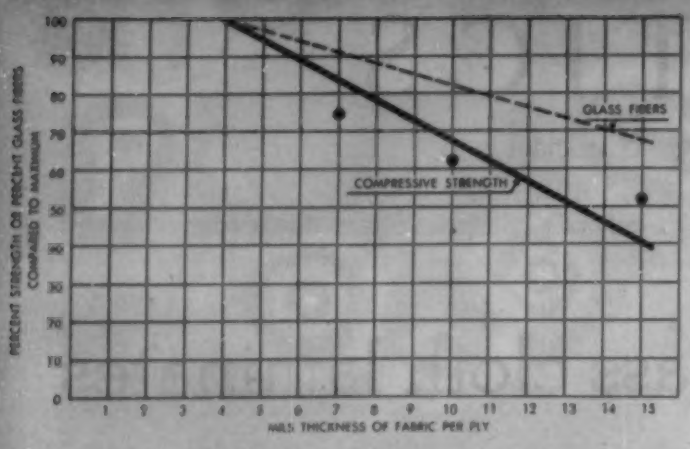
Plain woven fabrics

To give the user of Fiberglas fabrics a better basis for predicting the strength of laminates made with various fabrics, several graphs have been prepared. These show the relationship that exists between fabric thickness and various properties of the laminates. Since plain-woven fabrics have been in greater demand by laminators, this type of weave has been investigated more completely than the others. The graphs

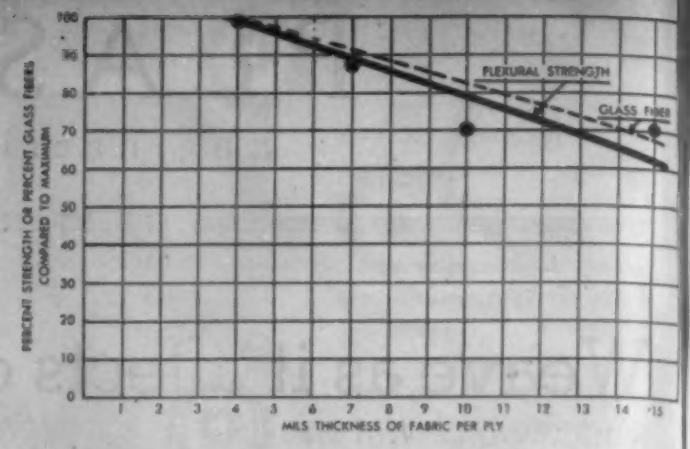
1—Relationship between the thickness of the glass fabric and the strength in tension of the glass laminates



* Registered U. S. Patent Office.
† Owens-Corning Fiberglas Corp.
[1] MODERN PLASTICS, *21*, 9, 89–111 (May 1944).



2—*Glass fabric thickness versus compressive strength*



3—*Effect of fabric thickness on strength in flexure*

report the strength of comparable laminates made with a representative resin and various plain-woven fabrics. For each property the maximum value obtained with any fabric has been considered as 100 percent. The lower values are expressed in correspondingly lower percentages of the maximum value.[2]

These graphs show that the thinnest cloth gives the highest strength properties, and that the thicker fabrics give decreasing strengths as the fabric thickness increases. Thus, ECC-162 cloth, which is 0.015 in. thick, gives the lowest strength values. The effect of cloth thickness is greatest in compression. It will be noted in the graph that percentage strength and percentage glass content have been shown on the same scale. It would be expected that the strength curve and the glass content curve should lie on the same line. This is not quite true. But the two lines do have about the same slope for all properties except impact. In general, strength increases with increasing glass content up to a point where voids are introduced because of insufficient resin content.

Tension—From Fig. 1, it will be observed that as different samples showed less than maximum strength in tension, there was a proportionately lower percentage of glass fiber in the laminate. The variation is slight, however, showing that tensile strength remains closely related to glass content.

Compression.—In Fig. 2, it becomes apparent that compressive strength drops sharply with reduced glass content. Thus, to assure high compressive strength there should be a high ratio of glass to resin. As explained previously, this is possible only by using thin cloths or cloths where the weave enables the laminator to secure the optimum resin-to-glass ratio. Resin-to-glass ratios should never be varied by reducing the resin content below the amount necessary to fill the voids in the cloth. If this is done, weaker laminates result.

Flexure—This is a combination of tension and compression. Since a beam is in tension on one side and compression on the other, the strength in flexure is, to a certain extent, a function of these two properties. It will be observed in Fig. 3 that as different samples showed less than maximum strength in tension, there was a proportionately lower percentage of glass fiber in the laminate. Flexural strength, however, remains closely related to glass content and, as in tension and compression, the thin cloths have the highest strength properties.

Modulus of elasticity—Young's modulus in flexure, as shown in Fig. 4, just about follows the predicted function. It appears that as glass percentage decreases, the modulus is reduced in about the exact proportion. There are slight variations, as the cloth thickness increases, but modulus remains closely related to glass cloth content.

Edgewise impact—Impact strength increases as the cloth thickness increases even though the glass content decreases (Fig. 5). This is contrary to theories on glass and resin combinations. It is believed that differences in crimp have an important bearing on this property. In the thick fabrics, larger yarns are used and the fiber bundles are bent or crimped more in weaving. The energy required to straighten these fiber bundles is reflected in higher impact strengths.

Discussion of test results—The ability of a reinforcing fiber to carry loads depends upon its direction in relation to the direction of the stresses applied. Hence, an analysis of the mechanics of fabric construction results in an understanding of the lower efficiency of the thick fabrics. When large yarns are woven so that one fill thread passes over one warp thread and under the next warp thread, the yarns in both the warp and the fill are bent in a series of "S" curves. This wave-like formation results in a column that is "crimped." It looks like the edge of a corrugated paper.

When compressive loads are applied to such a column, the tendency in the column is to collapse or to bend farther away from the neutral axis. If the column is straight and supported, the load is resisted by the increments of the column, all of which are under compression. But in "crimped" columns the increments are under compression and bending. This explanation suggests why laminates using cloths woven of heavy yarns are weaker in compression than laminates made with cloths woven of thinner yarns, where the "crimp" effect is not so pronounced.

This same "crimp" has a tendency to absorb impact before the fiber column is stressed. It acts to a certain extent like a cushion before the full load of the impact is applied to the fibers causing them to be stressed to their ultimate strength. This high impact strength is logically a characteristic of thick, plain-woven fabrics. In unidirectional cloth, fill yarns are very thin as compared to warp yarns. Consequently, the warp yarns remain substantially straight while the fill yarns take the crimp. This crimping of the weak fill yarns has very little effect on the strength of laminates. Reduced crimp seems to explain the high-compressive strength of thin fabrics as well as of unidirectional cloths.

Unidirectional cloths

In addition to plain weaves, two other basic glass fiber fabric designs are available for plastics reinforcement. The unidirectional cloths heretofore employed have had strong warp yarns with light fill yarns and may be distinguished as

[2] From the graphs shown in this article, it can readily be seen that the points do not fall on a straight line. A straight line is used merely as an indication of the variance in the particular properties as cloth thickness increased. It should be remembered that these graphs are made from limited test data and should not be considered design criteria.

warp unidirectional cloths. To these have been added a new weave having light warp yarns and strong fill yarns, identified as *fill unidirectional cloths.* To eliminate the necessity of cross laminating in the shop, warp unidirectional cloths may be combined with fill unidirectional cloths on a resin impregnating machine, and the two used as a single ply in making laminates.

Because unidirectional fabrics have had to be cross laminated to obtain balanced strength properties, they have not been used so extensively as the plain-woven fabrics. Yet, it is with these unidirectional fabrics that laminates of best strength properties have been obtained. There is no doubt that laminated production parts having strengths equaling or surpassing those obtained in the laboratory can and will be made. It is expected that many highly stressed parts will be made with these unidirectional fabrics as designers learn to utilize their properties.

To date, only unidirectional fabrics 0.010 in. thick have been evaluated. To correlate the strength properties of laminates made with these 0.010-in. unidirectional fabrics with the above curves, the following statements may be made:

Tension—Unidirectional cloths cross laminated, having only 5 percent more glass fiber content than plain cloths, show about one-third greater tensile strength than commonly used in thin plain-woven cloths.

Compression—With increased glass content of only 5 percent, the compressive strength of cross-laminated unidirectional cloths is increased about one-third over the strength of commonly used thin plain cloths.

Flexure—The flexural strength of cross-laminated unidirectional cloths with only a 5 percent greater glass content is about one-half greater than the flexural strength of plain, commonly used thin woven cloths.

Edgewise impact—Impact strength of cross-laminated unidirectional cloths is not as great as that obtained with thicker plain-woven cloths. However, this value is approximately equivalent to that obtained in laminates made with the medium weight, plain-woven cloths.

Modulus of elasticity—With an increase of 5 percent glass fiber content in cross-laminated unidirectional cloths, the Young's modulus increases about one-fourth over thin, commonly used plain-woven cloths.

Satin weave fabrics

As the result of an extensive research program, new glass fiber fabrics have been developed especially for plastics reinforcement and are now available. These fabrics are known as eight-shaft satin weaves. This construction is a variation of plain weave, having substantially the same strength yarn in warp and fill. These fabrics are woven so that each warp and fill yarn goes under seven and then over the eighth yarn instead of going over one yarn and under the next.

Satin weave fabrics are well known in the weaving industry and may be four-shaft, six-shaft, etc. The eight-shaft design apparently offers the best possibilities in glass fabrics for plastics reinforcement. This type of construction has a long float or length of uncrimped yarn so that the strength of the yarn may be more completely utilized. These cloths will not have as high strength properties as the unidirectional cloths, but they will have bidirectional properties substantially better than plain-woven fabrics of comparable thicknesses. For this reason, it will not be necessary to cross-laminate them. Limited tests on these fabrics indicate the above to be true, but complete test data are not yet available.

Mat products

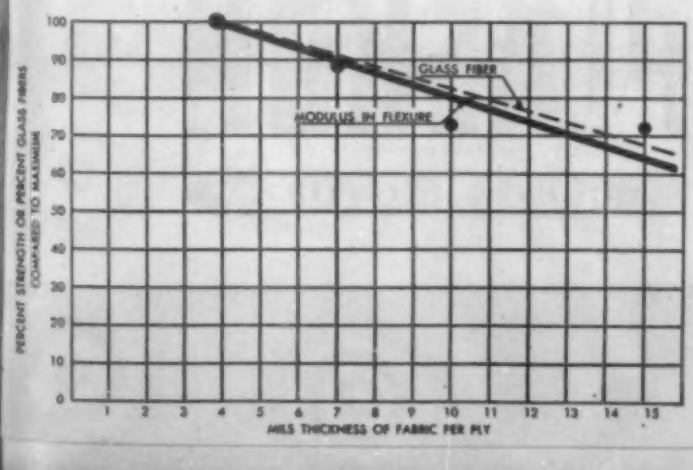
Several glass mat products—jackstraw arrangements of fine glass fibers uniformly distributed to form a thin, highly porous, felt-like material—have been used for plastics reinforcement. They do not possess the strength properties of cloths woven from continuous filament glass yarns. But they do have possible uses in parts where strengths as high as those obtained with glass fiber cloths are not required. They possess dimensional stability, low moisture absorption, and substantially equal strength in all directions.

Design considerations

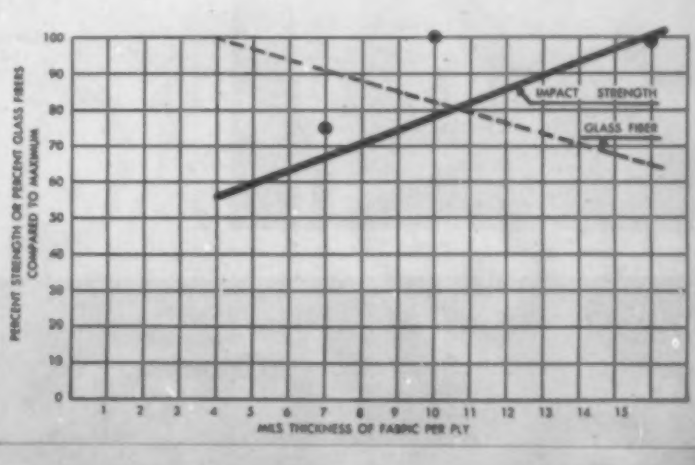
This discussion is intended only to indicate the variation in properties due to weaves and cloth thickness so that a laminator may select a cloth or cloths that appear to provide the properties desired in the finished laminate. In most cases, the part is subjected to tests by either the laminator or the customer, and the fabrication that meets their requirements is then accepted for production quantities. Where parts are to be designed to carry a specific load, such as in primary or secondary structural members in aircraft, it is recommended that specific tests be made on samples laminated under conditions as nearly as possible like those that will be encountered in volume production. Where such specific tests have to be made, either the resin manufacturer or the Fiberglas Corporation would cooperate in suggesting test procedures.

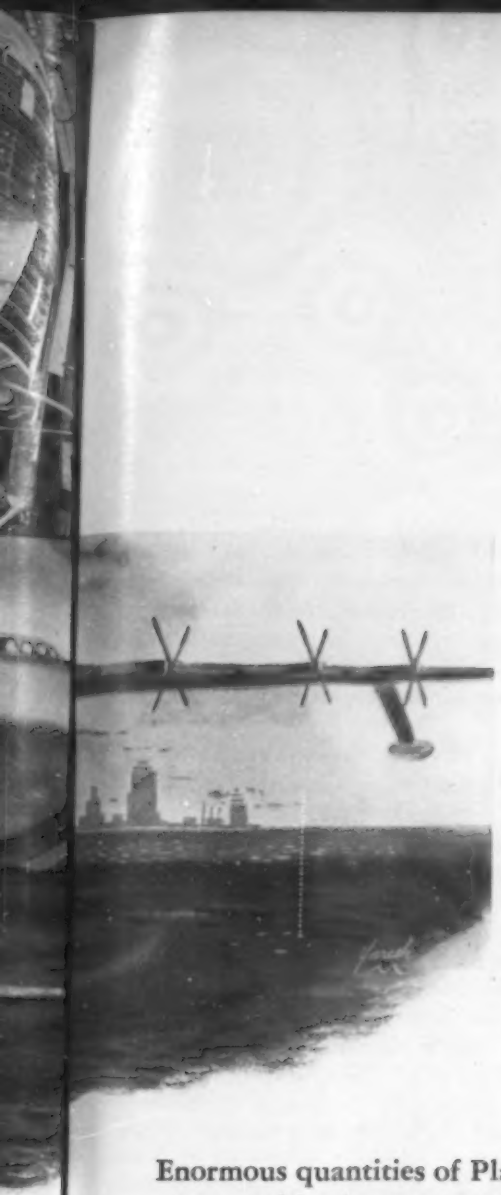
Testing is an endless procedure. New techniques, resins, cure times, catalysts, fiber forms, all these are variables, and a series of tests is required to evaluate each variable. This research is making available an ever increasing fund of knowledge on the unusual combination of many properties that distinguish glass fabric-reinforced plastics as a new basic material for industry.

4—*Relation between glass content and modulus in flexure*



5—*The thickness of glass fabric versus impact strength*





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No. 1. Looking down and aft on top of hull at nose door frame and flight deck. No. 2. Wing flap being moved out of jig. No. 3. Raising wing panel from assembly jig for installation of trailing edge structure. No. 4. Port wing under construction showing 4-engine nacelles.

Fabricating with frictional heat

by ROBERT N. FRERES*

TODAY the application of friction and its companion heat offers promise to the plastic industry. This new process, which applies only to thermoplastic materials, is divided into three classifications: welding, bonding and localized molding.

Welding of thermoplastic parts by this method is an amazingly rapid way of obtaining full strength welds. Bonding of thermoplastics to non-softening materials is similar to the welding process and depends on the flow of surface-heated material into undercuts. On a large plastic part, frictional heat is also used for localized molding with no effect on the remaining area. Patents that are pending on this process were frozen under wartime secrecy but were released recently for publication.

Friction welding in its simplest form means generating heat at the surface by rubbing two thermoplastic parts together and quickly applying pressure. A welding temperature is reached very rapidly because of high surface speed (6000 r.p.m. for a 1-in. diameter methyl methacrylate rod). The absence of air at the heating surfaces prevents heat losses, decomposition, burning, contamination and bubbles. Furthermore, most thermoplastic materials are relatively poor heat conductors, a factor that prevents the surface heat from being dissipated. Temperatures generated at the surface are inversely proportional to the square root of the heat conductivity of the materials.

As a result of the low heat loss and rapid generation of heat, only a minimum of Btu.'s are required to reach a surface welding temperature. This, of course, means that the cooling under pressure which follows is also accomplished in a short time. Nylon molded parts, which weld above 500° F., were heated as rapidly as low welding temperature (200° F.) materials like casein.

The heating cycle is not considered critical because the material is unlikely to overheat. At high temperature the material becomes soft and takes on the characteristics of a lubricant, lowering the frictional resistance and the temperature rise. The absence of air protects the hot material from decomposition or burning. This is probably the reason why nylon, which is critical to oxygen at high temperatures, is welded so successfully. Usually the correct welding temperature is reached when the material begins to flow from between the hot surfaces.

One of the advantages of this type of heating over all others is the presence of a clean virgin surface at the time of the final weld. During heating, a certain amount of material is displaced as it reaches the flowing temperature and carries with it any oil, dirt or contamination which may be on the surface. Thus, two pieces of acrylic cut with a hack saw can be welded together to form a homogeneous transparent part with light transmission equal to the case rod. Clean and smooth surfaces are not required for friction welding (Fig. 3).

The weld line of a friction-welded part is decidedly different from a hot-plate weld. With hot-plate welding the heat penetrates deeply into the plastic. Then, when the parts are forced together under pressure, a protrusion or bead is formed. This type of weld line is difficult to remove. When

* Mechanical Engineer, Rochester Button Co.

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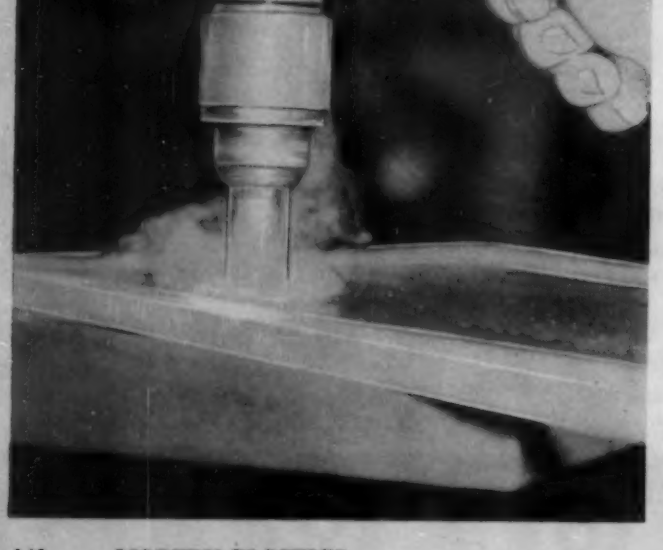
1



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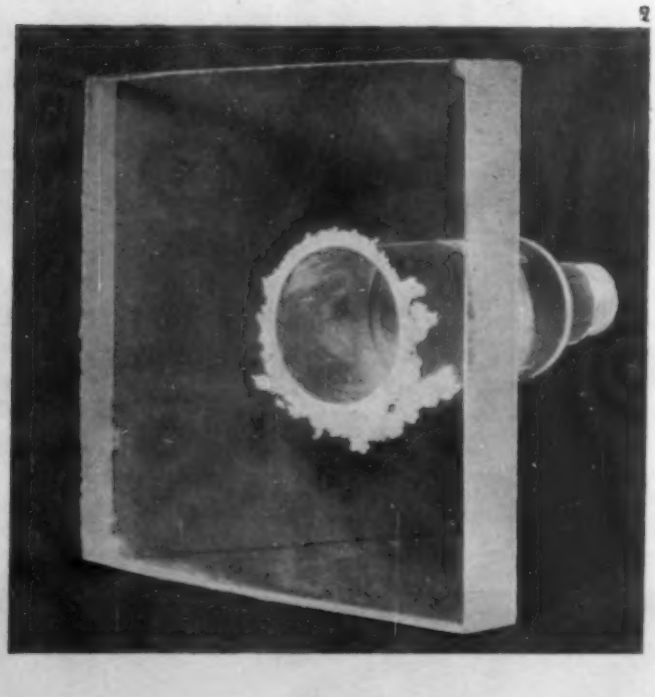
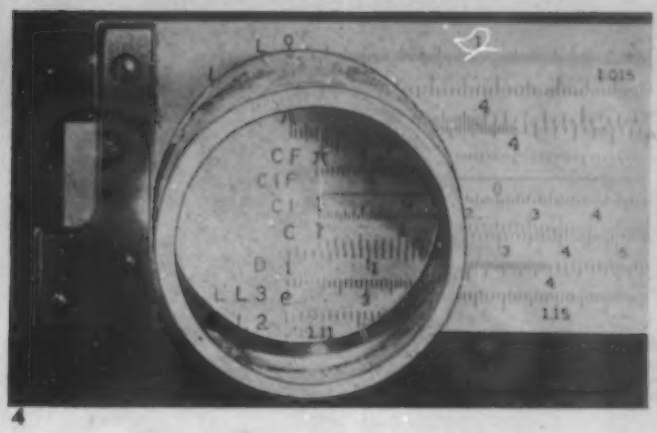


1—Circular thermoplastic pieces can be welded in a drill press. When the material starts to flow as a result of friction the power is released and downward pressure applied to the spindle. 2—The transparency of the resultant weld is excellent, and the light flash is easily removed

3



4

3—Two pieces of thermoplastic rod which have been roughly sawed apart with a hack saw preparatory to friction welding. 4—After being welded together by this process, the composite part has a clarity that is identical with that of an uncut rod. This is demonstrated by the sharpness of the slide rule figures viewed through a welded rod

it is taken off by grinding and polishing it may shrink back to form a groove due to the material's elastic memory. With friction welding the heat does not penetrate deeply and the flash is thin as in compression molding. This flash is also brittle because it flowed under high temperature and set without pressure. It can be removed by simple methods, such as tumbling or buffing.

In addition to sufficient heat, pressure is required in this process to bring the heated surfaces into intimate contact. Heat and pressure are applied in the same machine; there is no time lag or cooling off as in hot-plate welding. Pressures of about 300 p.s.i. are applied for a few seconds.

Not all thermoplastic materials presently being manufactured and marketed have as yet been tested. But every thermoplastic material submitted to Rochester Button Co. has been successfully welded by friction. Unlike thermoplastic materials, such as polystyrene to acrylics have not, however, been welded but only a few combinations have been tested up to the present time.

If the material is of the same chemical composition, there is no difficulty in obtaining a weld. Any combination of compression molded, injection molded or cast parts can be used. Similar materials, but of different colors, have a clean line of demarcation when welded together. Multicolored parts can thus be fabricated into a homogeneous structure.

Cemented and friction joints compared

Comparative tests have been made of cemented and friction-welded methyl methacrylate butt joints. The results obtained by a leading supplier indicate the improvement in physical properties:

	Solid rod	*Friction welding*	*Cemented*
Tensile strength, p.s.i.	7500	7200	4170
Charpy impact strength, ft. lb./in. of notch	6.9	6.1 outer section of rod	3.1
		4.8 inside section	2.1
Light transmission, total visible illuminant "C"	92.4	92.3	92.2

Cemented specimens broke clean at the joint by impact. Friction-welded specimens broke at the joint, but with a shattering break very much like that of solid rod. The tensile strength of a friction-welded part is approximately that of the solid rod.

There is no long list of products to testify as to the merits of friction welding. This is because the process is new and has been withheld by wartime secrecy, and because many applications in the development stage cannot be divulged. The few plastic men already familiar with the process are anxious for the opportunity of applying it to their own problems. We can point out only a few applications now, others will take up the lead.

Applications of this process

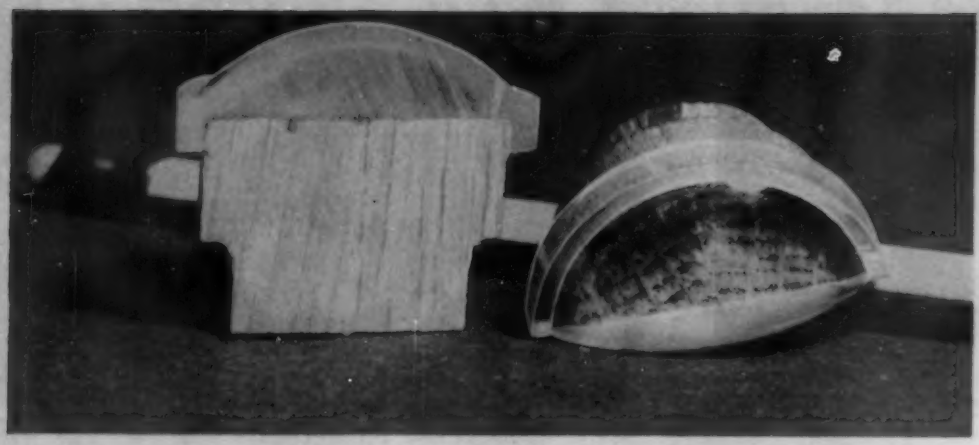
An optical lens is often composed of several polished parts cemented together to form a unit. If glass is replaced by accurate compression-molded plastic, the problem of cementing may present difficulties. On the other hand, plastic lenses have been welded together in close alignment to form a transparent homogeneous part. The operation does not affect the delicate lens surfaces because only the weld area is heated. Assembling is no longer a bottleneck, the parts are welded faster than they can be molded.

Containers that must be filled completely with liquid, excluding all air bubbles, can be welded while submerged in the liquid. The quality of the weld does not suffer even though the operation takes place in a liquid. Inflammable liquids can be used in spite of the high welding temperature because there is no air present for combustion (Fig. 7).

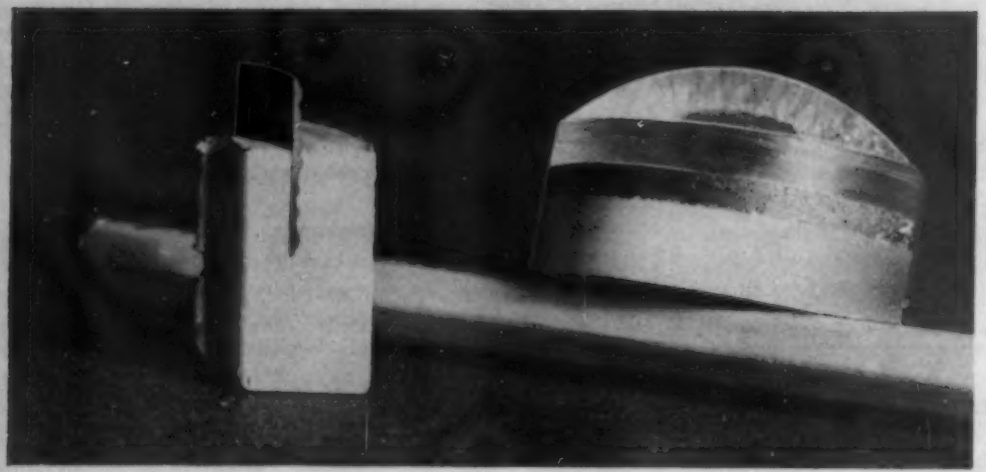
Parts that are either impossible or uneconomical to mold as a unit can be molded in sections and welded together to form a homogeneous solid piece. Also, parts too long for the available molding equipment can be molded in two or more sections and assembled later, somewhat like a prefabricating method as used in wartime shipbuilding.

Equipment for friction welding

The equipment required to weld by friction may already be installed in your plant. Circular parts can be welded in a drill press or lathe (Fig. 1). Irregular shapes, however, require a reciprocating motion. A circular part is chucked in a drill press and rotated against the stationary part at a speed sufficient to reach a welding temperature, but not at a speed which will make the operation too fast for manual control. When material begins to flow and smoke at the weld line, the power is released and downward pressure applied to the



5—Frictional heat can also be used to bond thermoplastic materials to non-plastic materials. This cross section of a knob shows how securely a methyl methacrylate top has been friction bonded to a large wooden base



6—The piece at the left is a very small segment cut from a round metal tube which had been sunk, by friction, into a piece of nylon. The part at the right is made up of nylon, porous bronze and methyl methacrylate, all welded together by friction heat

spindle. A few seconds after the motion has stopped, the part is removed, the weld already at full strength. With conventional chucking the complete operation can be done in 30 seconds. Frequently the flash can be polished off at the same time, by revolving the whole part.

Irregular-shaped articles that cannot be rotated are welded by imparting a reciprocating or oscillating motion. This can be done with electrical vibrations, vibrating air cylinders, the oscillation of an eccentric, etc. The self-compensating feature of frictional heat is most encouraging. A certain area may not receive its share of the rubbing velocity, but as the remaining area becomes heated and is lubricated by hot semi-liquid plastic, the normal pressure is increased on the cooler surfaces, thus increasing the frictional heat. For example, in welding a square object by oscillating corner to corner, the rubbing velocity is not uniform yet a suitable welding temperature is obtained throughout. Power consumption increases along with increasing weld area, but this is not serious when a flywheel is added to the setup.

Anything as inevitable as friction should be easy to generate. Yet each job will require a slighly different setup. Where production permits, automatic and semi-automatic machines can be built. Obviously, friction welding is not practical for all applications. However, there are some operations that can be done in no other way.

Bonding by frictional heat

Friction welding of thermoplastic material has a half brother which is called *bonding of composite structures by frictional heat*. A thermoplastic material is softened as the result of rubbing it against a solid non-softening part and upon applying pressure a bond is obtained.

A decorative plastic knob can be bonded to a wooden handle merely by rotating the knob against the wood until the plastic flows and then applying pressure. It has been found that the hot plastic will penetrate deeply into the wood or porous material. A methyl methacrylate rod bonded to porous bronze illustrates the flow of plastic under frictional heat. The plastic actually penetrated the $^1/_8$-in. thick porous bronze. Being under intense frictional heat the methyl methacrylate becomes a hydraulic fluid under pressure and transmits its pressure in all directions.

So as not to be limited by materials that have a natural roughness or porosity, such as wood, we think in terms of undercuts. A hot thermoplastic, obeying the laws of a fluid under pressure, will flow into the undercuts and produce a strong mechanical bond. Suppose a nylon rod is to be permanently fastened to an acrylic rod. These parts could be fastened by bonding a common brass tube to the inside of the rods. The tube has suitable undercuts, such as knurling, grooves or notches. As it is rotated against the plastic at high speeds, the brass tube cuts its way into the plastic. When the rotation is stopped, pressure is applied, forcing material into the undercuts. The plastic with tube bonded into it, can be rotated against the second member to produce a strong permanent bond. The brass cuts its own path under frictional heat. This is not the same as forcing the hot piece of brass with undercuts into the plastic. With friction the displaced material has an opportunity to escape a condition that reduces stress at the insert. This method of producing a bond is used by your dentist who anchors the fillings in your teeth by utilizing small undercuts.

By using this principle of flowing a plastic into an undercut, any thermoplastic material can be bonded to wood, glass, steel, ceramics, to suggest but a few materials. In contrast to many cements and glues which penetrate into undercuts,

friction-heated plastic in the fluid state is forced under pressure deeply into the small undercuts.

Molding by friction heat

Thermoplastic materials can be molded by supplying heat and pressure followed by cooling. If you are considering a small area, the total pressure is moderate. The third phase of frictional heating, therefore, involves localized molding.

A cast rod which is cut off with a band saw to a 3-ft length, requires a complex molded surface on the ends. Machining, polishing and buffing would be expensive. By rotating the required mold at high speed against the rod, you can mold the ends locally in a few seconds to a high polish. Heat is supplied by friction on the surface only. When the power is released, the cooling cycle begins, accompanied not by the usual 3000 p.s.i. mold pressure but by a pressure of 100 to 200 p.s.i. The cooling is rapid since only a surface heat is to be removed. When a large amount of material is to be removed, a heavy tool which is a good heat conductor should be used.

Useful applications can be found for localized molding, especially in the fabrication of sheets and rods. While it is true that a plastic rivet can be headed over by a hot tool, the result is a rough uneven finish. A rotating tool which generates its own heat at the surface will quickly cool, imparting a polished surface to the rivet.

In applying frictional heat to your particular problem, you will find that circular articles which are easily rotated are a natural. This is true whether the purpose is to weld thermoplastic parts, bond a thermoplastic to a non-softening material or perform a localized molding operation. The tooling cost will be slight and machines such as a drill press or lathe can be put into production.

Localized molding applies to small areas, otherwise the horsepower required to generate frictional heat and the application of pressure will become uneconomical. Except in special cases, a circular mold should be used. This type of molding is helpful where small designs or impressions can be added as a separate operation (Fig. 8). Fabricated parts that are too large or complex to be placed in a molding press may have small areas molded locally without affecting the principal part. A molder may produce a standard bottle screw cap, yet distribute them to his various customers with their brand name and a distinctively designed top. This can be done by a frictional molding operation in a drill press using a standard cap from stock.

Friction, usually our intrepid enemy, may prove useful to the plastic industry. Heat produced at the surface by friction is utilized to weld, bond or locally mold thermoplastic materials. A new tool for the plastic industry, it may have many interesting applications. A summary follows:

Welding of like thermoplastic materials	Frictional heat followed by pressure	Gas and liquid tight welds transparent, practically full strength, accurate alignment, rapid, ready for immediate handling
Bonding of thermoplastic to other materials	Frictional heat followed by pressure	Faster than cementing, can replace screws and inserts, many interesting possibilities, permanent
Localized molding	Frictional heat followed by pressure and cooling	Small areas can be molded without affecting main body of part

7—Containers such as this compass, which must be filled completely with liquid, can be welded while submerged in the liquid. The plastic compass at the left is unfilled while that at the right has been welded together

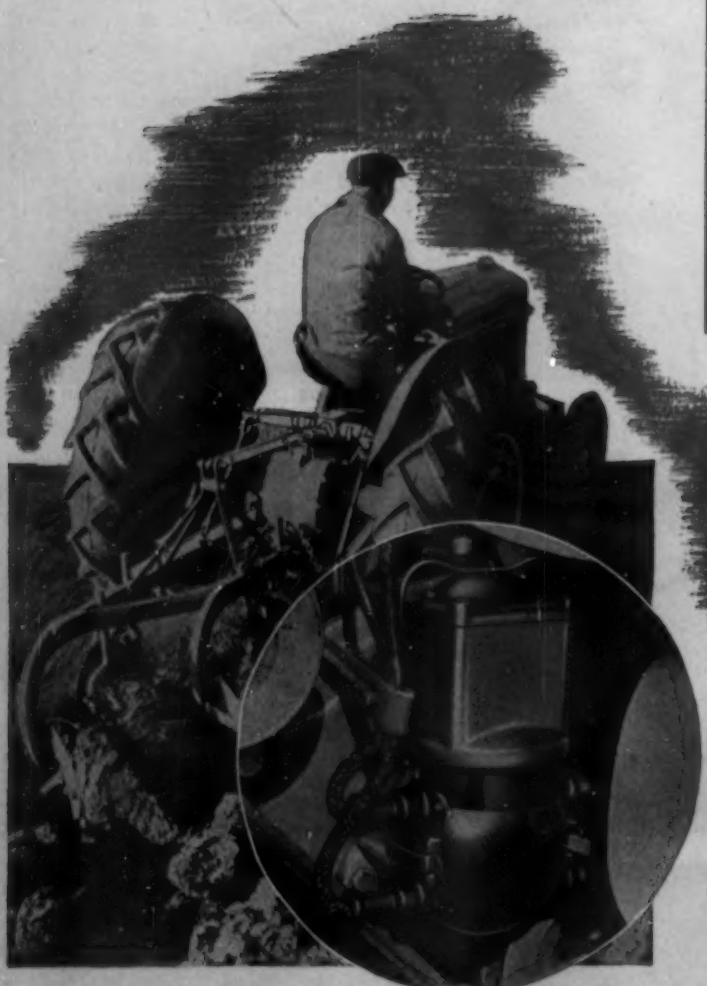
8—Friction heating can also be used for localized molding of thermoplastics. The rough and uneven surface of the plastic at the left takes a perfect impression of the metal die (center) when this method is used. The finished piece is at right

ANNOUNCING

TYPICAL PROPERTIES OF MELMAC 1500

GENERAL PURPOSE, ARC-RESISTANT INDUSTRIAL PLASTIC

	Average
Bulk factor	2.4
Specific gravity	1.45
Flexural strength, psi	11,000
Shrinkage, in./in. (4" x 1/8" disc)	
Mold, immediate	.008
After 8 hrs. @220°F.	.0015
Total aging shrinkage 48 hrs. @220°F.	.004
Water Absorption (%)	0.38
Arc resistance (ASTM) secs.	120-110
Dielectric strength (.080")	
Room temp. (S/T) v/mil.	465
100°C. (S/T) v/mil.	374-375



For automotive and tractor and stationary gasoline engine ignition and assembly parts, MELMAC 1500's strong insulating properties will assure efficient performance and guard against breakdown in spite of adverse service conditions.

For circuit breakers, switch boxes and similar electric equipment, the high dielectric strength of MELMAC 1500, plus its resistance to damage from electric arcs, will insure increased life and dependability.

Beetle · Melmac *Cyanamid*

MELMAC PLASTIC No. 1500

—a new dielectric material

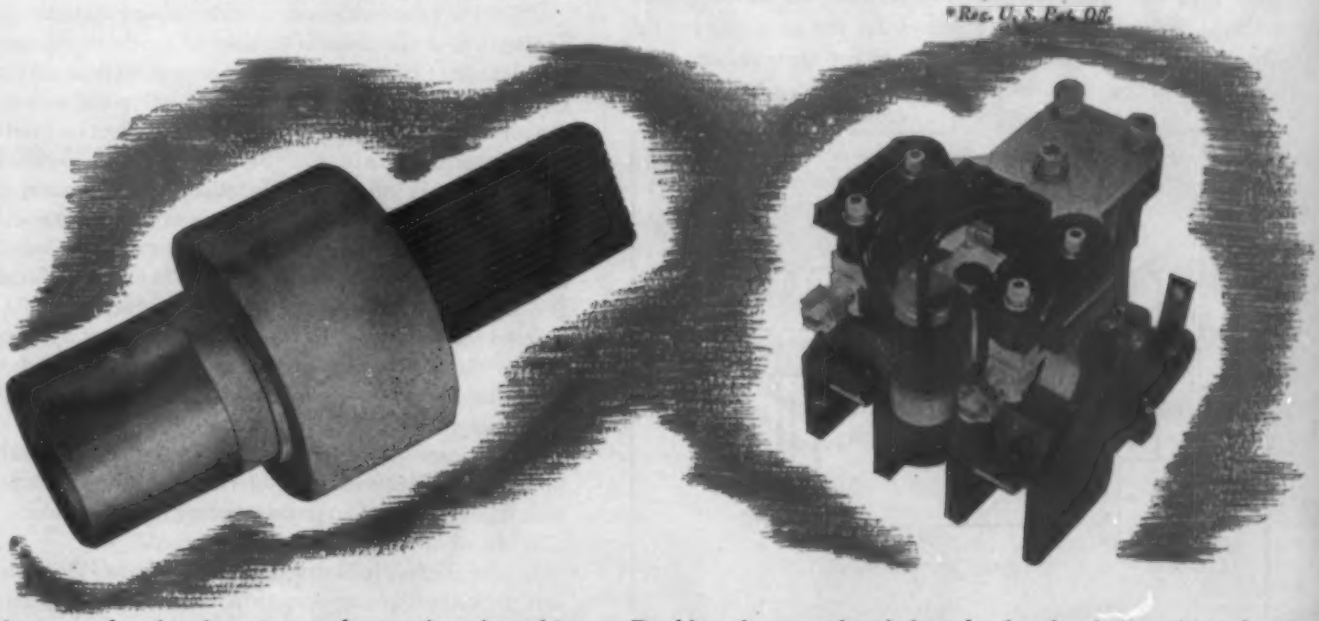
MELMAC* plastic 1500—another of Cyanamid's famous insulating MELMAC plastics—is a general purpose, arc-resistant industrial plastic for use in electrical parts, switchgear, circuit breakers, terminal blocks, automotive and tractor ignition parts, and similar applications. Its high dielectric strength, high heat and arc resistance, and non-inflammability help assure uninterrupted performance of electric equipment in spite of dust, dirt, humidity, or other adverse service conditions.

MELMAC 1500 is a wood-flour-filled material, readily moldable in existing equipment by either compression or transfer methods. Further information on this new industrial plastic, with its excellent combination of physical and electrical properties, will be supplied promptly. We shall also be glad to work with you on its adaptability to your dielectric requirements.

AMERICAN CYANAMID COMPANY • PLASTICS DIVISION

32 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

*Reg. U. S. Pat. Off.



Insulating parts for electric motors and control, such as this plastic collar on a brush holder for heavy duty mining machinery, can be molded of MELMAC 1500 to provide high mechanical strength and arc resistance needed for hard service.

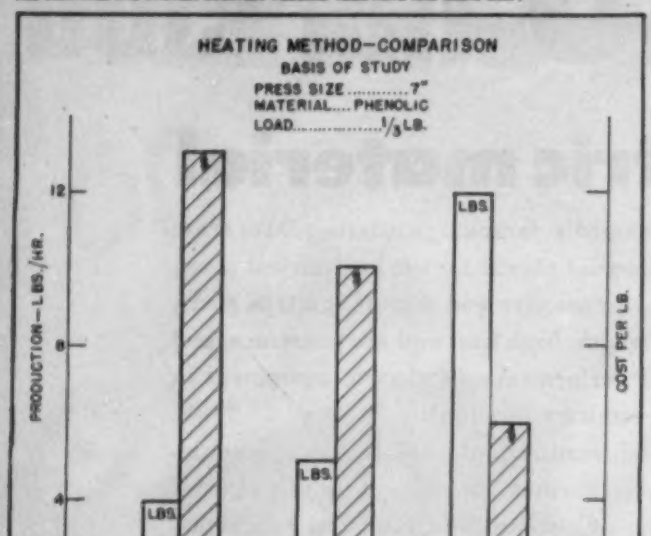
Double-pole control switch and other insulating pieces for electric control boards molded of MELMAC 1500 will give long, efficient service because of the material's high arc resistance, dielectric strength, and resistance to impact.

Plastics Melurac · Laminac · Urac

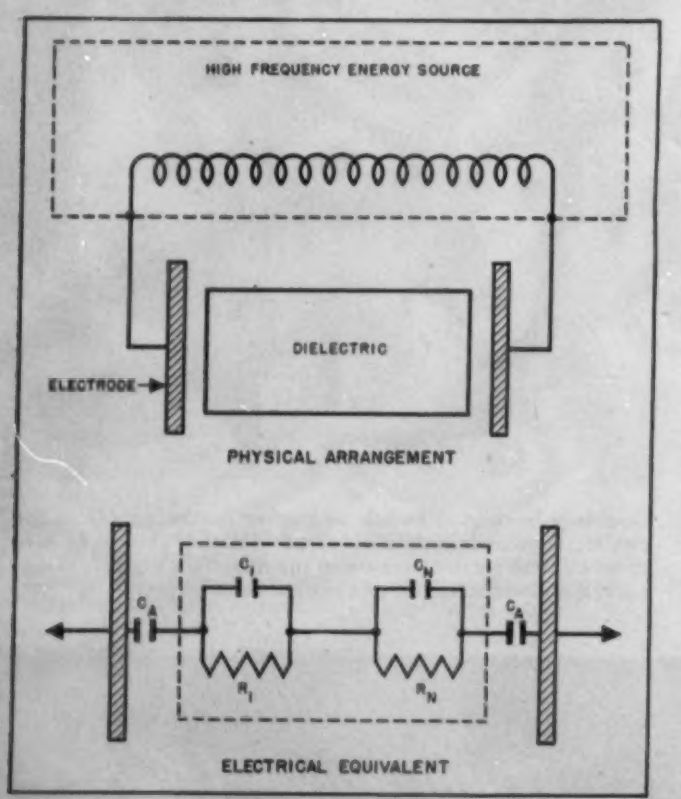
Dielectric heating

by V. W. SHERMAN*

ALL DRAWINGS AND PHOTOS. COURTESY FEDERAL TELEPHONE AND RADIO CORP.



1—Comparison between heating cost per pound and the production in pounds per hour when steam, infrared lamps and dielectric heating are used to heat the molding material. Arbitrary units are shown on the cost per pound scale. The data supporting this chart was drawn from the production and cost records of a leading molder



2—The physical arrangement of a simple dielectric heating arrangement with its equivalent electrical circuit

A COMMON denominator of the plastics, rubber, textile and food industries is an extensive use of heat for the purpose of processing products which are of themselves notoriously poor heat conductors. All the conventional heating means, including infrared lamps, are somewhat limited in their application because they can be applied only to the surface. Surface methods have two outstanding difficulties: 1) they are slow, being limited by the allowable temperature at the surface, and 2) they are non-uniform due to the temperature gradient which exists between the surface and the center of the mass.

High-frequency dielectric heat is of industrial interest primarily because it will develop heat uniformly throughout masses of material. With uniformity is coupled the additional virtue of speed, and with speed and uniformity comes control of certain important chemical and physical product changes.

High-frequency heating as applied to industry is a controlled exploitation of dielectric hysteresis. By exposing an electrically non-conducting material to an alternating electrostatic field, a cyclic stress reversal is experienced by each molecule of the material. The heat that is developed is the direct result of the frictional forces overcome during the distortion or reorientation of each molecule.

Economy of dielectric heating

When the power engineer considers a new dielectric heating application in the plastics, rubber or synthetic rubber fields, it is definitely recommended that he first analyze this method of heating from the standpoint of all possible operating economies. In addition to its immediate effect on production, the new technique will tend to cut such expense items as maintenance, steam capacity, utilization of floor space, etc. A fair and complete economic study is extremely important.

The growth of electronic heating can only be based upon economic advantage to the user. When the application of this equipment is based on theory or hope, it should be restricted to the laboratories because this type of application in industry is apt to lead to complete dissatisfaction and actually retard the spread of a good technique into its proper fields.

The application of electronic heating equipment to diversified fields such as plastics, textiles, rubber and food calls for a fundamental understanding of the production techniques of each field, as well as an understanding of the economic limitation placed upon the products concerned.

In the plastics industry, the application of electronic heat was an immediate answer to a number of long-felt needs. For many years high pressure and high temperature were a *must* if the molding material was to be forced into the desired shapes. Pressures ranged as high as 500 tons. The total time for closing and curing often amounted to as much as 30 or 40 minutes.

The contribution of dielectric heat to this problem was a very simple and effective one. A few seconds of preheating at a temperature near 300° F. converted a cold, rock-like preform into a soft, putty-like mass. With this change the molder found it possible to secure the desired results at pressures approximately one-tenth those previously required.

* Manager, Industrial Electronics Division, Federal Telephone and Radio Corp.

The cost of electronic heating units for the plastics and rubber industries depends upon the power output. It ranges from about $2000 per kw. at 1 kw. output, down to less than $500 per kw above 25 kw. output. However, this cost is readily justified by the high quality product and the increased production. The industries in which this equipment is used are, for the most part, production-minded and recognize that proper equipment is always justified when it results in a lower unit cost.

Figure 1 is a chart that was based on production and cost figures of one of the country's leading molders. It shows the relative cost of heating a pound of material by dielectric or by two other common methods of heating, and the production in pounds per hour using these various heating methods. The heating methods other than high-frequency used in this comparison are: 1) steam, where the heat is transmitted from the steam-heated mold to the surface of the product and 2) infrared lamps where the molding material is preheated by a radiant surface process before it is placed in the molding press.

Avenues of expansion

In the plastics industry the use of electronic preheat has opened at least two major avenues of expansion. First, it makes possible the production of larger, more complicated molded products. And second, it facilitates the molding of precision parts in which the accurate location of delicate inserts and complete freedom from any dimension change is assured.

On the negative side of the picture it should be noted that electronic heat is of dubious value for small, thin-walled pieces, such as buttons, coin tokens, etc. Here the parts are so thin and the shapes so simple that surface heating of the material can be readily accomplished and little or nothing gained by a preheating operation.

The arrangement of the fixtures

The physical arrangement of heating fixtures is extremely simple. The plastic material is normally placed between two flat plates which are supplied from a high-frequency voltage source. In nearly all cases it is necessary to allow for the normal thermal expansion of the material during the heating period. There are two ways of doing this.

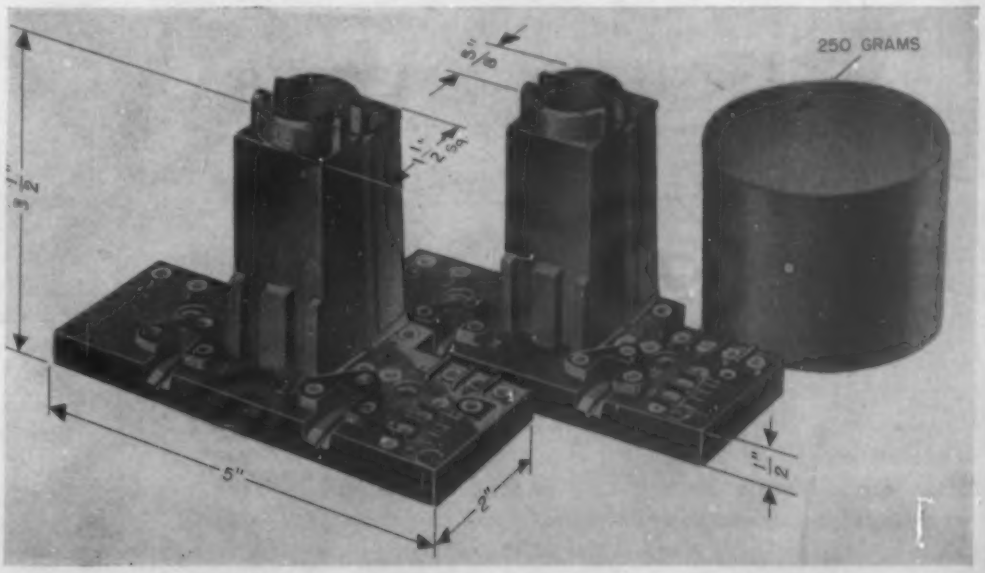
1. A small air space is provided, which is sufficiently large to allow for the expansion.

2. The upper plate rests upon the work but is free to move as the product expands.

Use of the small air space provides the most flexibility, and is considered to be the more practical method of handling this problem. Figure 2 shows the physical arrangement of a simple dielectric heating setup, together with its equivalent electrical circuit.

Dielectric heating also makes possible intricate low-pressure molding. A typical factory setup (Fig. 3) shows a 3-kw. Megatherm dielectric heating unit and oven. Figure 4 shows the part that was being run at the time these photographs were taken. This piece requires a deep contour mold with 21 inserts. The previous method of molding had necessitated the use of closing pressures up to 120 tons and had resulted

3—In this typical factory setup, the 3-kw. dielectric heating unit is located immediately adjacent to the press



4—Before dielectric heating was used in the molding of this piece, closing pressures up to 120 tons were necessary. And even then the ratio of rejects was high. Dielectric heating of the preform produced a free-flow condition in the mold and gave the parts a glossy finish

in a high ratio of rejection in this part because of its irregular wall thickness, deep-draw and 21 metal inserts. Dielectric heating of the preform produced a free-flow condition in the mold and gave the parts a high, glossy finish free from flash and the closing pressure was reduced to 37 tons.

Heating fixtures used in the drying of thin films, textile webs, printed matter, etc., may have the heating electrodes arranged in the form of a system of rods which have alternate members connected together. Each of the two sets of rods thus formed are connected as one element or plate to the radio-frequency source. By passing the thin layer of material over the circumferential surface of such a system of alternately charged rods, very rapid and successful drying can be secured. The direction of the flux between the rods and through the thin film of material is approximately parallel with the surface of the material. The work of our company has indicated that a considerably practical advantage results from thus positioning thin-filmed materials approximately parallel with the direction of the heating flux.

Operating Frequencies

The question of best operating frequency is highly controversial. Theoretically, the heating rate can be increased either by an increase of voltage or by an increase of frequency. The increase of voltage is more desirable from an engineering standpoint and is normally exploited almost to the point where there is danger of flash-over. As a matter of practical expediency, however, it has been found necessary in most cases to use a frequency of 10 mg. or higher in order to get the desired heating rate without danger of flash-over. In many cases the physical size of the job dictates the use of frequencies as low as 2 mg. The use of a "magic frequency"—a frequency at which the loss factor of the material exhibits a hump or peak value—is not generally practical. This is due to the fact that the frequency at which the peak value occurs varies greatly for different material (Fig. 5). Ten to 30 mg. is the common range now in use, although frequencies as low as 2 mg. have been used to advantage.

So much material has already been published relative to the fundamentals of dielectric heating, that it is neither necessary nor profitable to repeat discussions of underlying theory or derivations of equations. It is of value, however, to present certain formulas in practical shop form. They are:

(1) Heat required = specific heat × lb. × degrees F. = Btu.

(2) Power required, kw. =

$$\frac{\text{Btu. [as calculated by (1)]}}{\text{1.05 sec. of desired heating time}}$$

(3) Volts required per in. thickness of work piece =

$$26{,}500\sqrt{\frac{\text{kw. [as calculated by (2)]}}{\text{Loss factor} \times \text{area (sq. in.)} \times \text{frequency (mg.)}}}$$

It is necessary to know the required volts per inch thickness of work piece for two reasons:

1. To keep the voltage per inch × inches of thickness within the capacity of the electronic heating unit that is available.
2. To keep the required total voltage within safe practical limits for the material being heated (5000 to 7000 volts per in. for materials releasing volatiles and moisture and 10,000 volts per in. for most dry materials). The following example illustrates the application of these formulas to a specimen representative of a typical shop problem.

Material data		*Process data*	*Electronic Equipment*
PHENOLIC			
Weight, lb.	2	Preheat temp.	...
Size, in.	8 × 8 × 1	= 200 F.	...
Sp. Heat	0.35	Preheat time	3 kw. output
Loss factor	0.3	= 60 sec.	14.5 mg.

(1) Total heat required = 0.35 × 2 × 200 = 140 Btu.

(2) Kw. power required = 140/60 = 2.3 kw.

(3) Working volts required per in. =

$$26{,}500\sqrt{\frac{2.3}{0.3 \times 64 \times 14.5}}$$

= 2410 volts

A voltage of 2410 volts per in. is permissible since phenolic preforms will normally tolerate 5000 to 10,000 volts per inch. This voltage is available from the low voltage tap (5000 volts) on the Md-3 model manufactured by our company and the excess of 2590 volts is available to support an air space and thus permit expansion of the material.

Industrial electronics has reached the stage where it must be taken out of the laboratory and be treated in exactly the same way as any other industrial tool. It is now in the same category as welding control and should be treated from the same practical viewpoint.

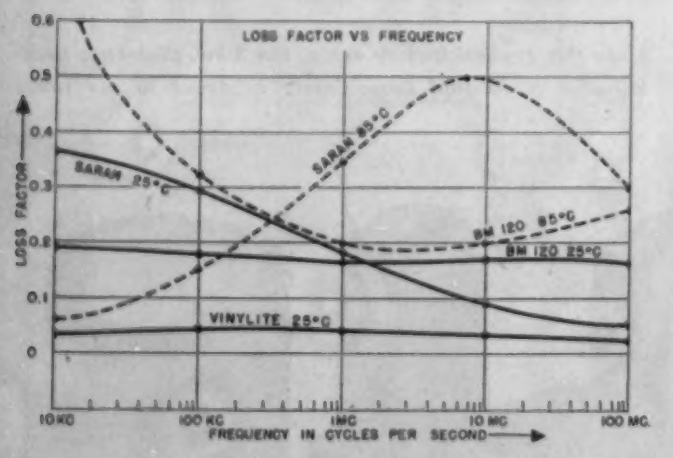
The material presented in this article has been intentionally restricted so as to give an industrial rather than a laboratory type picture. The points developed might be summarized in order of importance as:

1. Electronic heating equipment has arrived at a functional stage of design. In many cases it has long since graduated from the laboratory and become a practical machine tool.

2. Dielectric heating is of value to industry because it provides fast and uniform heating of materials which are of themselves poor heat conductors.

3. The application of dielectric equipment should be restricted to cases which offer economic advantage to the user.

4. Electronic heating equipment is supported by a background much older than itself. It is the direct descendent of heavy-duty transmitters and power tubes.



5—Electrical loss factor of a number of different plastic materials shown as a function of frequency and of temperature. These several curves show that in order to operate constantly at the frequency of maximum loss factor, the dielectric heating unit would have to be capable of continuous and automatic frequency variation to a degree that is not feasible at the present time

New outlook

Shatterproof Tenite sunglasses, originally designed for military use, are heartily endorsed by skiers, sailors, and fishermen. Molded Tenite forms bridge, temples, and brow strip. To remove glare and transmit colors in their true values, the single wide lens is cut from light-polarized film laminated between Eastman Acetate Sheet.* Tenite sunglasses are pleasant to the touch in any kind of weather, light in weight, and comfortable to wear. Many other Tenite products born of wartime emergency have been adapted to peace because of their confirmed superiority—among them, wallboard trim, rain gages, name plates, bugles. The speed and economy with which Tenite can be molded or extruded into beautiful, durable products make Tenite one of the most widely used plastic materials today. For information as to the adaptability of Tenite to your product, write

TENNESSEE EASTMAN CORPORATION
(Subsidiary of Eastman Kodak Company),
KINGSPORT, TENNESSEE.

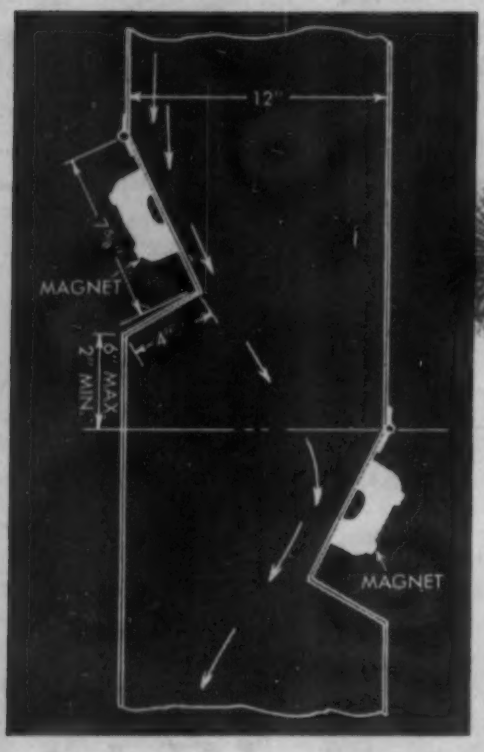
Tenite

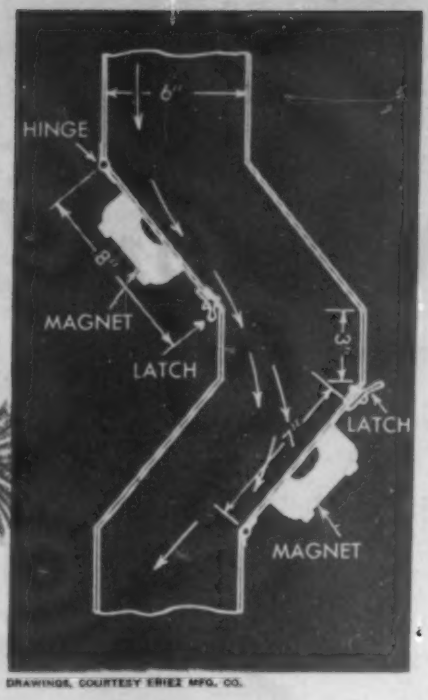
an Eastman plastic

Tenite sunglasses molded by Waterbury Companies for Polaroid Corp. and by American Optical Co.

** Eastman Acetate Sheet is a product of Eastman Kodak Co., Rochester, N. Y.*

Permanent magnets and their uses





DRAWINGS, COURTESY ERIEZ MFG. CO.

The principal advantage of non-electric, permanent magnets is that they require no wiring for their operation. They are particularly effective when arranged in series. Often they are hinged to facilitate removal of metal

NON-ELECTRIC (permanent) magnets are playing an increasingly important part in eliminating the "tramp iron" problem which has been plaguing the plastic industry for many years. Because they require no wiring for their operation these units can be inserted with a minimum of trouble in plastic processing lines wherever there is danger of ferrous particles being present in the material.

One very powerful magnetic separator of this type which can be made any size to fit existing or new equipment has been developed by the Eriez Manufacturing Co. The need for wiring is eliminated in this unit through the use of magnetic Alnico alloy which is mounted on special steel and insulated with brass, aluminum or plastics. The magnet needs only a 6 in. or more length of spouting for proper installation. Heretofore, a conveying unit approximately 18-in. long was required for the installation.

There are many places where magnets can be used to advantage in the plastic industry. For example, users have found it advisable to install a powerful plate magnet in front of packaging machinery since there is always the possibility of nails, nuts, bolts, scale, etc., falling off the machinery.

Since this new unit is capable of separating only slightly magnetic materials as well as those that are strongly magnetic, plastic materials can be processed magnetically to remove oxide scale, feldspar, barytes, nephelene syenite, fine shot iron, iron-bearing minerals and other impurities. The magnetic strength of this magnet is said to penetrate a 7-in. high stack of magazines stacked on the magnet's face. Properly installed, the unit will remove ferrous metallic substances from plastic ingredients coming within 2 in. of its working surface. It does a good job on even a heavier flow. On difficult materials or applications, or in suction pipe, a series of magnets often provides the answer (Figs. 1 and 2).

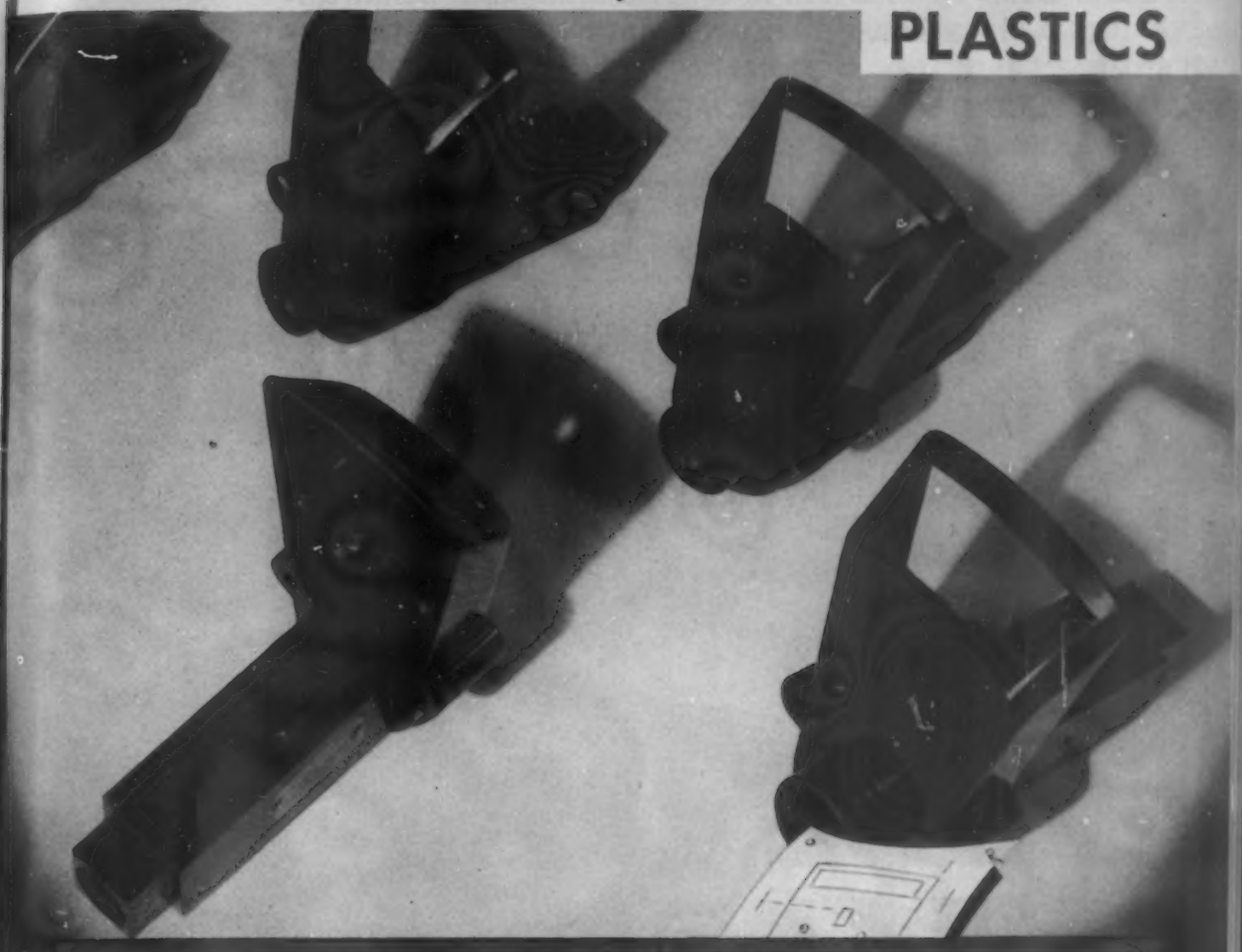
A still wider use for this non-electric magnet is found in the plastics reclaiming field. Rejects are often swept off the floor along with a nail, steel insert or small wire. The sweepings are dumped into the grinder which is often damaged by these pieces of metal. Fires and explosions have been known to result from pieces of metal getting hot from friction when unable to work through grinding rolls.

Fire prevention bureaus, particularly the Dust Explosion Hazards Committee of the National Fire Protection Association, strongly urge the use of magnetic separators in the processing of plastic ingredients where one small piece of iron striking the side of a chute can cause a spark, sometimes resulting in disastrous dust explosions.

The Factory Insurance Association recently issued the following statement: "The use and value of permanent magnets has increased in recent years, due to improvements in design of the physical magnet and composition of the metal itself. The permanent magnet is simple, requires practically no maintenance other than cleaning of collected trash, is easily understood and maintained by ordinary labor, is not dependent upon an outside source of power, is relatively light in weight and extremely flexible in design."

There are two standard means of installing these plate-type magnetic separators. Most commonly the working face of the magnet is substituted as a part of the conveying unit, such as steel spout or feed table (Fig. 2). Any ferrous pieces or particles in non-magnetic material passing over the magnet are immediately pulled out and held to the face plate. The magnet is hinged and may be swung down from the spout to remove the metal accumulation. Again, the magnet is simply suspended over a shallow flow of material. Among the advantages of this new magnet are: 1. It is not affected by heat or vibration. 2. It operates efficiently in wet, moist or liquid materials. 3. It carries a 10-year service guarantee.

A Trouble-Shooting Idea . . . Molded in PLASTICS



Another Plastic Success Story

Designed to house a galvanometer-indicator in a resistance testing set, this unit presented an unusual problem. In the mold design prepared by TECH-ART engineers, precision dimensions were easy to specify, but the necessity of making the mold in 5 pieces pointed up some complications—Any attempt to flow the standard plastic material into the mold would require a pressure great enough to displace some of the precision-spaced inserts. To forestall this problem, TECH-ART engineers worked with the material maker—had the material carefully reformulated to increase its flowability, while preserving the necessary characteristics of toughness, dielectric strength and resistance to warpage. Then TECH-ART mold builders built the mold. When placed in the hands of TECH-ART's skilled molders, the special mold and special material turned the trick—making this special job another Plastic Success Story by TECH-ART.

TECHNICAL NOTES

While many product designs can be simplified for production in plastics, this particular design called for a definite positioning of 7 inserts on 6 different faces—making it necessary to build the mold in 5 separate pieces.

When a simple product design becomes a complicated plastics problem, look for the answer among these *four* trouble-shooting factors—*sound product engineering; skilled mold-building craftsmanship; full knowledge of plastics materials; adequate production facilities manned by resourceful personnel.* Our engineers will be glad to show you in detail how these TECH-ART tools can help build quality standards in your own products and equipment.

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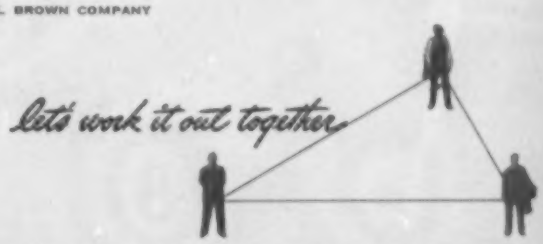
*HANDBAG BY THE PAUL BROWN COMPANY



High accomplishment in plastics will result only when manufacturer, designer, fabricator and raw materials producer put their skills together, working as a team. In the interests of achievement, therefore, Dow urges you to save time and money by putting its experts to work on *your* problem. They'll do their part.

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TECHNICAL SECTION

DR. GORDON M. KLINE, Technical Editor

Polyvinylpyrrolidone*

This report on a new type of plastic developed during the war by two German scientists, Dr. Fikentscher and Dr. Herrle, reveals its method of preparation and its unique properties, especially that of solubility in both water and organic solvents. More than 300,000 units of a 2.5 percent solution of this polymer were administered to German wounded as a blood substitute.

The new method for the synthesis of acrylic derivatives described in Dr. Reppe's report on page 162 may result in a considerable decrease in production costs for plastics of this type. In fact, the use of metallic carbonyls in organic synthesis opens up a whole new field for the ready conversion of simple and cheap raw materials into complex molecular substances of great industrial importance.

These reports were obtained by a Plastics Team under the leadership of Dr. G. M. Kline in the course of investigations in Germany conducted by technical representatives of the Ordnance Department, Chemical Warfare Service, Quartermaster Corps and other groups. It is of interest to note that the two published in this issue were part of a collection that the German Army had ordered destroyed; only one set was ever found and that in an obscure building well camouflaged in a dense grove of pine trees. Dr. Kline was recently presented with the civilian emblem for service in the European Theater of Operations, in connection with the survey and investigation of German facilities, by Major General G. M. Barnes, Chief of Research and Development, Ordnance Department.

THROUGH Reppe's work the polyvinylpyrrolidones have become available from acetylene and formaldehyde via butinediol, butanediol, pyrrolidone and vinylpyrrolidone. These polymers have a new type of property in that they are easily soluble in water as well as in organic solvents. Their aqueous solutions are absolutely neutral. In contrast to the polyacrylic salts and similar to the polyvinyl alcohols, they do not contain ionogenic groups. They are somewhat albuminoid in their constitution.

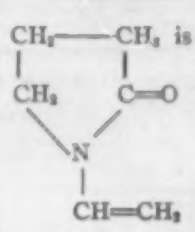
For commercial production polymerization of the pure monomer in block[1] and in solution has been developed first; these processes produce Periston and Kollidons with *k*-values[2] of 20 to 100. The copolymerization is being further investigated.

* A report, Polyvinylpyrrolidone (Periston, Kollidon), was presented at the 26th Kuko (Plastics Committee) meeting in Ludwigshafen on Nov. 10, 1943, by Dr. Fikentscher and Dr. Herrle, I. G. Farbenindustrie A.-G. This translation was prepared by Mrs. I. G. Callomon and Dr. G. M. Kline, National Bureau of Standards.

The Department of Commerce is merely distributing this technical information which has come into its hands from captured German territory. This information should be made available to all United States citizens interested in it but use of it by anyone must be and is at one's own risk in so far as the United States or foreign patent violations are concerned.

I. Block polymerization

Vinylpyrrolidone (VP)



is easily block polymerized in a simple manner with hydrogen peroxide.[3] Thirty-five kg. VP are added to 150 cc. of hydrogen peroxide and heated to 110° C. Without additional heating the temperature rises to 180–190° C. through polymerization. The still hot and melted polymer is poured from the kettle and cooled on plates. After grinding in a ball mill, one gets a fine, white, somewhat hygroscopic powder.

The disadvantages of this process are a more or less strong discoloration from yellow to brown, due to the high temperature, and the development of strong vapors of unpleasant odor attributable to the rapid initiation of polymerization. Further, the polymers contain up to 10 percent of monomeric VP, probably responsible for the material's hygroscopicity.

If the polymerization kettle is used repeatedly without being cleaned, the polymer sticking to the kettle walls becomes insoluble as a consequence of overheating, thus strongly impairing the filterability of the aqueous solutions. Finally, the *k*-values attainable in block polymerization are low.

In spite of all this, Periston is still being manufactured by this process because its low viscosity is desirable for its application as a blood substitute.

In order to remove the toxic monomeric VP, the powdered polymer is extracted with ether before being dissolved in water and filtered.

To temper the initial reaction, we add 3 percent of water and obtain polymers of lighter color and better filterability.

II. Solution polymerization[4]

In the long run, block polymerization would not be satisfactory for commercial production and polymerization in aqueous solution was therefore developed.

It was observed that polyvinylpyrrolidone, like pyrrolidone itself, has the tendency to form hydrates. According to the investigations made in our physical department, one can assume from the heat of reaction and the infrared light absorp-

[1] Translator's note: Polymerization of the monomer as a mass without the use of solvents or emulsification.

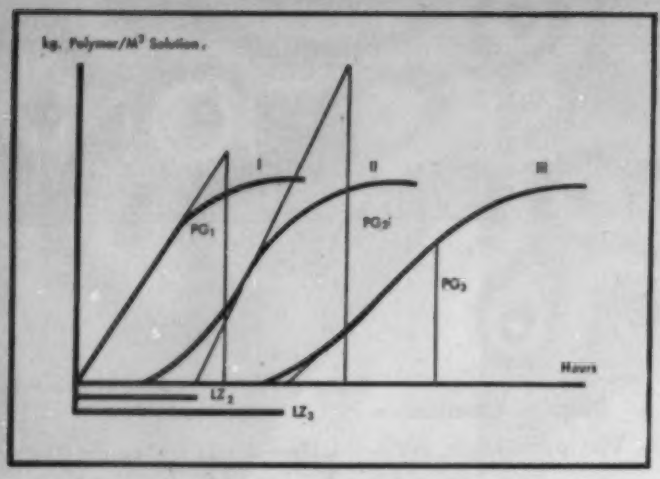
[2] Translator's note: Fikentscher's viscosity coefficient *k*, is calculated as follows:

$$\frac{\log \eta_{rel}}{c} = \frac{75k^2}{1 + 1.5\,k.c} + k$$

where c is the concentration in g./100 cc. of solution and η_{rel} is the ratio of the viscosity of the solution to that of the pure solvent. The *k*-values are reported as 1000 times the calculated viscosity coefficient in order to avoid the use of decimals. This is the usual German practice. This note corrects and supplements the information regarding Fikentscher's k-value given on page 152A of the October issue of MODERN PLASTICS.

[3] O.Z.11 697 Schuster, Sauerbier, Fikentscher.

[4] O.Z.14 473 Reppe, Herrle, Fikentscher.



1—*Determination of LZ and PG from concentration-time curves*

2—*The dependence of PG and k-value on ammonia concentration during the polymerization of vinylpyrrolidone*

TABLE I.—DEPENDENCE OF LZ, PG AND *k*-VALUE ON THE AMOUNT OF AMMONIA ADDED
(30 percent VP in water; 0.5 percent of 30 percent hydrogen peroxide; temperature 50° C.)

Ammonia (100%)	*LZ*	*PG*	*k-Value*
percent	*min.*		
None	Does not start		...
0.04	180	200	63
0.1	5	250	53
0.4	0	500	56
1.6	0	850	62

tion that one mol of vinylpyrrolidone combines with one mol of water.

When the polymerization is conducted in an aqueous solution with hydrogen peroxide, the reaction mixture becomes the more acid the more hydrogen peroxide is used. The acid reaction causes the splitting off of acetaldehyde which has an unfavorable influence on the polymerization and the polymer. It is therefore necessary to add alkaline acting or buffering compounds.

At this point, it was observed that the addition of ammonia or amines or their salts have—apart from their buffering action—a strong activating effect on the polymerization. With the help of ammonia, or also of amines and their salts, it became possible to shorten the latent period and to increase the polymerization speed so much that polymerization can be done at lower temperatures and with smaller amounts of catalyst, thus obtaining high *k*-values.

Definition of polymerization velocity—Polymerization velocity (PG) is defined as the number of kilograms of polymer formed per hour per cubic meter of solution. In the case of emulsion polymerization, the volume of solution is taken as that of the aqueous phase and not the volume of the whole emulsion.

The PG is found by plotting the amount of polymer formed in kilograms per cubic meter of solution as the ordinate against the time of polymerization as the abscissa and drawing the tangent at the point where the straight line portion ends and the curve bends toward the abscissa. The tangent of the angle made by the intersection of this straight line with the abscissa gives the PG (Fig. 1).

Definition of latent period—Latent period (LZ) is defined as the time elapsed in minutes from 0 point to the point of intersection of the tangent to curve with the abscissa (Fig. 1).

The percentages of the accelerator (hydrogen peroxide) and of the activator (ammonia) are based in the case of solution polymerization always on the amount of monomer.

Unless otherwise stated, an initial pH of 8 was used and this was not allowed to fall below pH 7.

Effect of ammonia and amines—Table II shows the effect of ammonia and a few amines in the presence of a small amount of hydrogen peroxide on the latent period (LZ), polymerization velocity (PG) and the *k*-value.

The added amounts of amines are proportional to their molecular weights. Consequently, ammonia is more active than the amines in its effect on both LZ and PG. The type of amine added seems to have no essential influence on the *k*-value.

That the action of ammonia and the amines is a specific one becomes evident from the fact that polymerization had not started even after 4 hr. when equivalent amounts of sodium hydroxide and sodium bicarbonate were added.

TABLE II.—DEPENDENCE OF LZ, PG AND *k*-VALUE ON THE TYPE OF AMINE
(30 percent VP in water; 0.5 percent of 30 percent hydrogen peroxide; temperature 50° C.)

Material added	*Amount added percent*	*pH*		*LZ min.*	*PG*	*k-Value*
		Initial	*Final*			
None	...	7	Had not started even after 4 hr.			
Ammonia (100 percent)	0.1	9	8	5	250	52
Monoethylamine	0.27	11	8	12	175	58
Triethylamine	0.6	11	7.5	30	175	43
Tetramethylammoniumhydroxide	0.58	12	12	120	ca 100	58
Sodium hydroxide	0.23	12	Had not started even after 4 hr.			
Sodium bicarbonate	0.5	7	Had not started even after 4 hr.			

Effect of amount of ammonia—The amount of ammonia added has a great influence on the PG, but less on the LZ and *k*-value, as shown in Fig. 2 and Table I.

With the small amount of 0.04 percent of 100 percent ammonia (based on VP), 0.5 percent of sodium bicarbonate had to be added later in order to retain the neutral reaction.

Effect of pH—The pH also has an effect on the LZ and the PG, but none on the *k*-value, as shown in Table III.

Effect of temperature—The PG is most critically dependent upon the polymerization temperature (Fig. 3 and Table IV).

The influence of the temperature on the *k*-value is astonishingly small; namely, about 2 units per 10° C.

Effect of amount of hydrogen peroxide—On the other hand, one can fix the *k*-value by the amount of hydrogen peroxide added, as shown in Fig. 4 and Table V.

By further reducing the amount of hydrogen peroxide below 0.25 percent, the *k*-value can be increased to 90 and more. In this case it is necessary to add the small amounts of hydrogen peroxide in portions because it is being consumed (see Table VI).

The curve for dependence of the *k*-value on the amount of hydrogen peroxide is so easily reproducible that, to obtain a certain *k*-value, it is possible to read the necessary amount of hydrogen peroxide directly from Fig. 4 or to compute it from the following equation:

$$k = \frac{40}{c^{0.3}}$$

If the amount of hydrogen peroxide is increased to more than 2 percent, the *k*-value decreases according to this equation while the PG again decreases. With 5 percent of hydrogen peroxide one obtains a *k*-value of about 20.

Effect of concentration of vinylpyrrolidone.—The concentration of vinylpyrrolidone in the original mixture also has an influence on the LZ, PG and *k*-value.

As Fig. 5 and Table VII show, at first the PG increases strongly with increasing concentration up to about 30 percent VP, as is customary for solution polymerization. It then remains constant to about 60 percent VP, but decreases sharply thereafter.

The decrease with increase in concentration is attributed to a declining hydrate formation. With 100 percent vinylpyrrolidone, the polymerization does not start at all as would be expected from the above. This indicates that water is very important for the polymerization process.

The *k*-value's extensive independence of the concentration

TABLE III. DEPENDENCE OF LZ, PG AND *k*-VALUE ON THE pH OF THE SOLUTION[a]

(30 percent VP in water; 0.5 percent of 30 percent hydrogen Peroxide; 0.1 percent of 100 percent ammonia; temperature 50° C.)

Initial pH	*LZ*	*PG*	*k-Value*
	min.		
6	60	45	56
9	5	250	55
10	0	210	55

[a] The values in Tables III and V were determined by Dr. Lantzsch.

TABLE IV.—DEPENDENCE OF LZ, PG AND *k*-VALUE ON THE TEMPERATURE

(30 percent VP in water; 0.5 percent of 30 percent hydrogen peroxide; 0.1 percent of 100 percent ammonia)

Temperature	*LZ*	*PG*	*k-Value*
° C.	*min.*		
30	40	100	63
50	5	250	56
70	2	530	54
90	0	1200	52

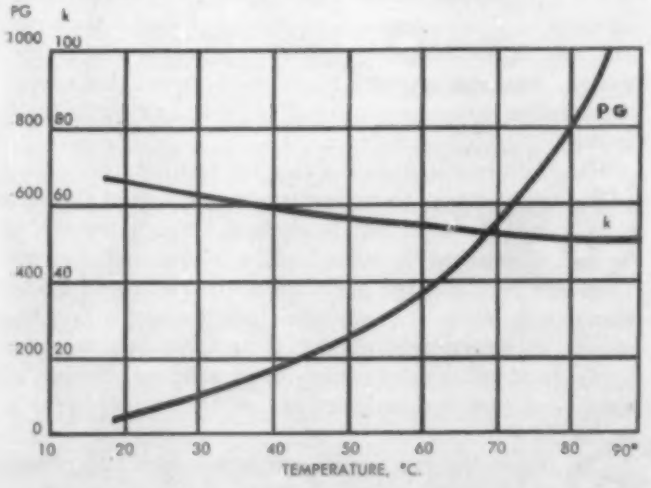
TABLE V.—DEPENDENCE OF LZ, PG AND *k*-VALUE ON THE AMOUNT OF HYDROGEN PEROXIDE

(30 percent VP in water; 0.3 percent of 100 percent ammonia; temperature 50° C.)

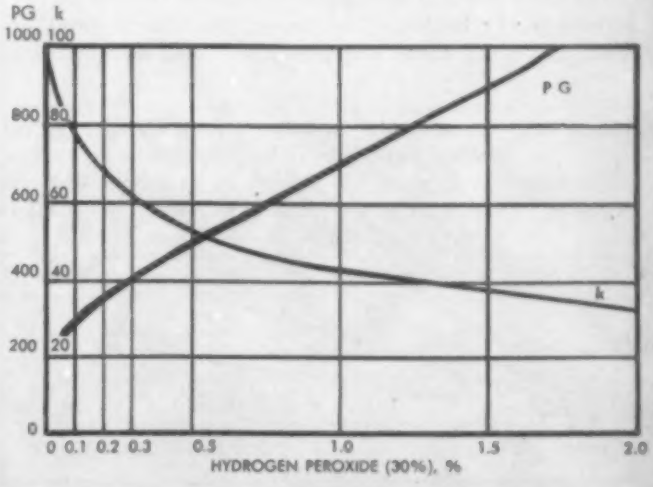
Hydrogen peroxide (30%) based on VP	*LZ*	*PG*	*k-Value*
%	*min.*		
2.0	0	1100	33
1.5	0	800	38
1.0	0	700	45
0.5	0	400	56
0.25	10	350	65

TABLE VI.—DEPENDENCE OF LZ, PG AND *k*-VALUE ON VERY SMALL AMOUNTS OF HYDROGEN PEROXIDE

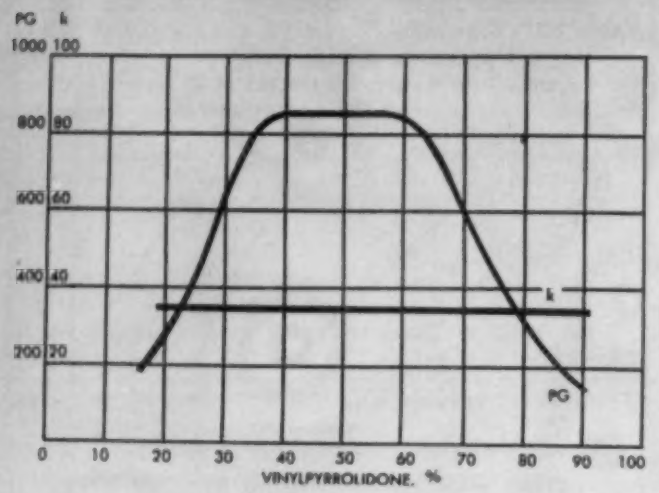
Hydrogen peroxide (30%) based on VP	*LZ*	*PG*	*k-Value*
%	*min.*		
2 × 0.1	20	290	80
3 × 0.05	23	225	90
3 × 0.01	Does not start		...



3—The dependence of PG and k-value on temperature during the polymerization of vinylpyrrolidone compound



4—Dependence of PG and k-value on hydrogen peroxide concentration during polymerization of vinylpyrrolidone



5—*The dependence of PG and the k-value on the vinylpyrrolidone concentration*

is surprising; this is not ordinarily observed in solution polymerization.

Effect of rate of addition of monomer.—It is possible to carry out the polymerization by adding the monomeric solution without changing the *k*-value very much through the addition itself or the rate of addition. This is technically of great advantage because of the loss of heat in highly concentrated batches. The experimental data in Table VIII show this relation.

The small increase of the *k*-value from 30 to 38, for addition times from 0 to 120 min., is probably caused by the gradual decomposition of the hydrogen peroxide and the decrease of its concentration with prolonged addition time.

Effect of oxygen.—By excluding the molecular oxygen from the air—i.e., by displacing it with nitrogen—one obtains a further shortening of the latent period and an increase in PG, especially at lower temperatures.

If 30 parts of VP remain standing in 70 parts of water together with 0.5 percent of 30 percent hydrogen peroxide and 0.1 percent of 100 percent ammonia at 20° C., no polymerization occurs in the presence of oxygen from the air. Using a stream of nitrogen, on the other hand, polymerization starts at once and is practically finished within 2 hours. Without the addition of ammonia, no reaction takes place even using nitrogen. The *k*-value of the product was determined as 56.

The commercial *N*-vinylpyrrolidone may contain up to 2 percent of oily impurities which are insoluble in water; in small quantities these impurities are often eliminated as

TABLE VII.—DEPENDENCE OF LZ, PG AND *k*-VALUE ON THE CONCENTRATION OF VINYLPYRROLIDONE

(30 percent VP in water; 2 percent of 30 percent hydrogen peroxide; 0.4 percent of 100 percent ammonia; temperature 50° C.)

VP	*LZ*	*PG*	*k-Value*
%	*min.*		
10	Does not start		...
20	0	250	34
40	0	850	39
50	0	850	35
60	0	850	35
80	10	350	35
90	10	150	...
100	Does not start		...

TABLE VIII.—DEPENDENCE OF *k*-VALUE ON THE RATE OF ADDITION OF A 50 PERCENT SOLUTION OF VINYLPYRROLIDONE IN WATER

(2.0 percent of 30 percent hydrogen peroxide; 0.4 percent of 100 percent ammonia; temperature 50° C.)

Time of addition	*k-Value*
min.	
0 (Everything added at start)	30
12	33
120	38

turbidity when dilution with water takes place during the polymerization.

III. Commercial production of the Kollidons

In accordance with the preceding investigation, the commercial production of the Kollidons is done, at present, in discontinuous 400-liter batches and the 30 to 60 percent solution is either added at the start or gradually during the polymerization.

The product is dried by spraying in a Nubilosa dryer. The drying of solutions of higher viscosity is difficult. Kollidon F 33 ($k = 33$) is polymerized in a 30 percent solution because the product can still be dried in this concentration. In order to dry the high viscosity solutions of the higher polymeric Kollidons (up to *k*-values of 100) or the more concentrated solutions, it is intended to try drying them on rolls.

For a greater production one can switch to a continuous polymerization.

IV. Properties of the polyvinylpyrrolidones

Pure polyvinylpyrrolidones, polymerized by light as a catalyst, are glass-clear masses. Exposed to air, they gradually absorb water and form highly viscous solutions in water. The E.P. (softening point) is over 100° C.

In contrast to the high polymer produced by light polymerization, the block polymer is more or less discolored yellow to brown and of low viscosity.

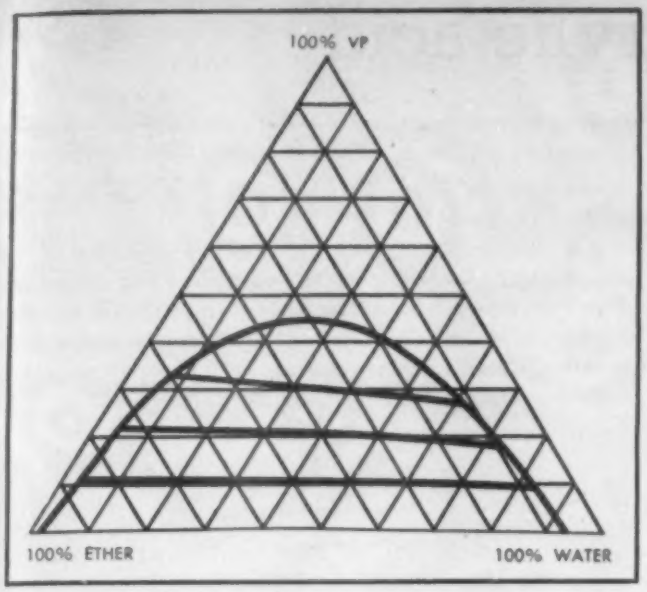
By solution polymerization, colorless products from $k = 20$ to $k = 100$ can be produced.

Solubility—The polyvinylpyrrolidones—also called Kollidons—give clear solutions in water and of more or less high viscosity depending on their *k*-value. They cannot be precipitated by strong acids. Only highly concentrated warm solutions of alkalies and sodium chloride will salt them out. The reaction of the aqueous solution is completely neutral, and the solutions are very resistant to saponifying agents. When boiled with concentrated alkali, they form an insoluble product.

An especially new feature is that the Kollidons are soluble and compatible with water and organic solvents at the same time. They dissolve easily in alcohols, ketones, tetrahydrofurane, chlorinated hydrocarbons, pyridine and lactones. They only swell in esters and aromatic hydrocarbons and are insoluble in ether and aliphatic hydrocarbons. For that reason, by determining whether a turbidity develops when ligroin is added to monomeric vinylpyrrolidone, one can ascertain whether the monomer has started to polymerize in storage.

The monomeric vinylpyrrolidone is miscible in all proportions with all organic solvents.

Nonmiscibility of VP in ternary systems—In order to extract the remaining monomeric vinylpyrrolidone from aqueous



6—Nonmiscibility of the system vinylpyrrolidone/ether/water with the tie lines at 25°C.

solutions of the solution polymer, its nonmiscibility in some ternary systems was investigated. Figures 6 to 8 show the systems:

Vinylpyrrolidone/ethyl ether/water
Vinylpyrrolidone/ethyl acetate/water
Vinylpyrrolidone/methylene chloride/water

The positions of the tie lines and the distribution curves (Fig. 9) indicate that of the three solvents methylene chloride has the best extraction capacity.

With low concentration of VP, the solubility of VP in methylene chloride is ten times that in water.

While in the system methylene chloride/water, the monomeric vinylpyrrolidone for the most part passes over into the methylene chloride, it is surprising that the circumstances in the polymer solution are reversed. In the presence of water, polyvinylpyrrolidone is scarcely soluble in methylene chloride or, in general, in organic solvents not miscible with water, whereas it dissolves easily in these solvents in the absence of water. Therefore, it is possible even in production to extract monomeric vinylpyrrolidone from aqueous solutions of polyvinylpyrrolidone with methylene chloride.

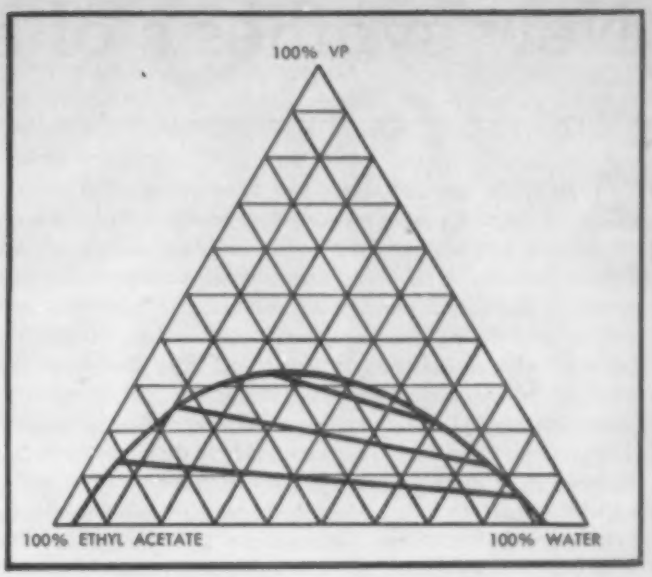
If water and solvents miscible with water are used at the same time, there occurs in certain concentrations nonmiscibility; i.e., the solutions separate into two liquid phases.

Nonmiscibility of polyvinylpyrrolidones in acetone/water—For the system polyvinylpyrrolidone/acetone/water this nonmiscibility has been studied thoroughly (Fig. 10).

Nonmiscibility was determined by adding to several concentrated solutions of Kollidon in acetone (left side of the isosceles triangle) and in water (right side of the triangle) increasing amounts of water and acetone, respectively, until turbidity occurred.

In Fig. 10 it is evident that very small additions of water to a solution of Kollidon in acetone quickly causes the separation into two phases, probably because a hydrate is formed which is insoluble in acetone.

Abnormal position of the conjugated points of polymerically nonhomogeneous Kollidons—If one tries, through direct mixing of the three components in a proportion that corresponds, for example, to points A, B or C within the nonmiscible area,

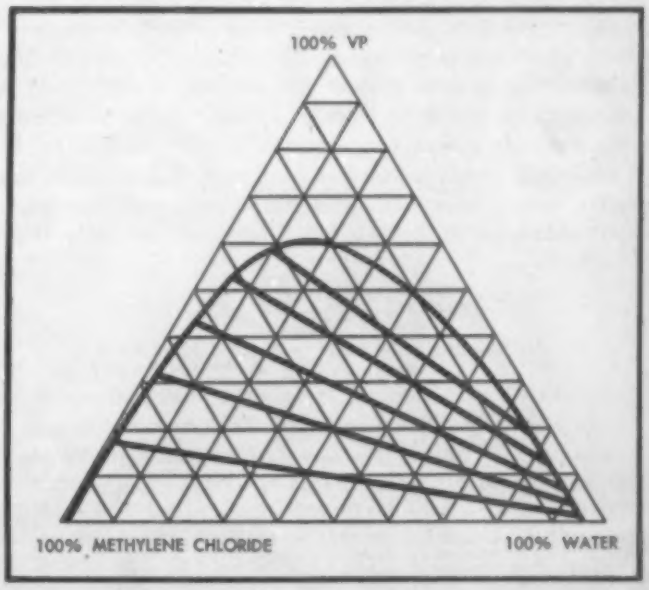


7—Nonmiscibility of the system vinylpyrrolidone/ethyl acetate/water with the tie lines at 25°C.

to determine the conjugation line (Fig. 11) by analyzing the composition of the two phases, one would find that the conjugated points A_1, A_2, B_1, B_2 or C_1, C_2 are not—as first expected—on the boundary line of nonmiscibility but outside or inside of this line.

Also the corresponding points A_1–A–A_2, B_1–B–B_2, or C_1–C–C_2 are not situated on a straight line, as is usually the case in nonmiscibility. When determining nonmiscibility for Kollidons of different k-values, one finds that the nonmiscibility becomes greater with increasing k-value (Fig. 12). In this case, the extent of nonmiscibility seems to be independent of the degree of molecular homogeneity of the homologous polymer. Even in comparing two products with the k-value 15, one of which was obtained by direct polymerization and the second by mixing 5 parts of Kollidon of k-value 33 with 21 parts of monomeric vinylpyrrolidone, the resulting nonmiscibility regions are duplicated within the limits of error.

Dependence of nonmiscibility on (*Please turn to page 212*)



8—Nonmiscibility of the system vinylpyrrolidone/methylene chloride/water with the tie lines at 25°C.

New synthesis of acrylic acid*

ABOUT a year and a half ago, it was decided to include in the new studies on acetylene, in which we have been engaged in Ludwigshafen for about 10 years, the cheap carbon monoxide. It was first intended to produce acetylene mono- or dialdehyde through a combination of acetylene and carbon monoxide. In the pursuit of these experiments it proved to be an extremely lucky coincidence that from the start nickel or nickel carbonyl was chosen as a reaction agent or CO-carrier between acetylene and carbon monoxide. This was because it soon became evident that only metallic carbonyls, or such metals or their compounds which are capable of carbonyl formation, make a reaction between acetylene and carbon monoxide possible. The reaction did not result, as we had hoped, in the formation of acetylene mono- or dialdehyde, but rather acrylic acid was obtained in the presence of water in a surprisingly smooth reaction.

Other compounds with a labile hydrogen atom showed the same behavior. Thus, with acetylene and carbon monoxide, alcohols produced acrylic esters, amines gave acrylic amides, mercaptans gave acrylic thioesters or the tautomeric thioacrylic esters, and organic acids gave mixed anhydrides with acrylic acid, as can be seen from the following equations:

$$C_2H_2 + CO + H_2O \rightarrow H_2C{=}CH{-}COOH$$
acrylic acid

$$C_2H_2 + CO + ROH \rightarrow H_2C{=}CH{-}COOR$$
acrylic ester

$$C_2H_2 + CO + RSH \rightarrow H_2C{=}CH{-}COSR$$
acrylic thioester

$$C_2H_2 + CO + RNH_2 \rightarrow H_2C{=}CH{-}CONHR$$
N-substituted acrylic amide

$$C_2H_2 + CO + RCOOH \rightarrow H_2C{=}CH{-}CO{>}O{<}R{-}CO$$
mixed acrylic carboxylic anhydride

Thus, carbon monoxide as such or as a metallic carbonyl serves as a link for the addition of acids or halogens.

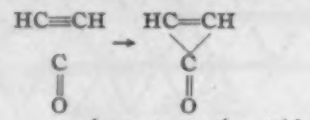
One can explain the reaction process in the following way: Acetylene reacts in its isomeric form $H_2C{=}C{<}$ with carbon monoxide to give methylene ketene $H_2C{=}C{=}CO$. It is known that the ketenes react with water and alcohols, even spontaneously at low temperatures, to give acids or esters. Thus acrylic esters are formed from acetylene, alcohols, and carbon monoxide or metallic carbonyls even under extremely mild conditions. The two following equations show these reactions:

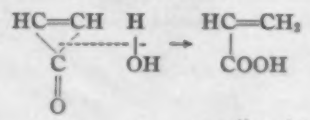
$$H_2C{=}C{=}CO + H_2O \rightarrow H_2C{=}CH{-}COOH$$

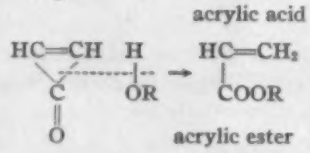
$$H_2C{=}C{=}CO + ROH \rightarrow H_2C{=}CH{-}COOR$$

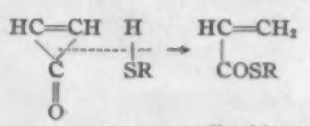
But this theory does not explain the analogous reactivity of the doubly substituted acetylene which has no labile hydrogen atoms and which, therefore, cannot rearrange itself into the ketene. It furthermore does not explain the occurrence of two different reaction products, as is the case in di-substituted acetylene.

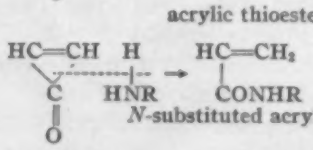
We, therefore, assume the intermediate formation of the hypothetical cyclopropenone, a 3-membered ring compound, from acetylene and carbon monoxide, which then in combining with compounds containing labile hydrogen atoms, such as water, alcohols, amines, mercaptans and carboxylic acids, splits according to the following equations:

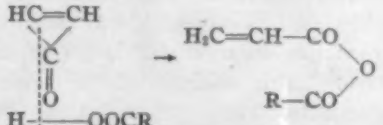

cyclopropenone (unstable)


acrylic acid

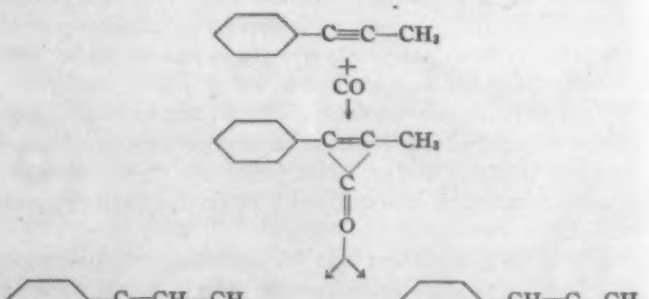

acrylic ester


acrylic thioester


N-substituted acrylic amide


Mixed acrylic carboxylic anhydride

The two isomers, alpha and beta, substituted acrylic acids or acrylic esters, are, indeed, obtained in accordance with our theory from methylphenylacetylene, as would be expected from the two possible ways for methylphenylcyclopropenone to split:


1-Phenylpropene-1-carboxylate-1

1-Phenylpropene-1-carboxylate-2

The described reactions of acetylene and carbon monoxide on the one hand and compounds with labile hydrogen atoms,

* A report presented at the 24th Kuko (Plastics Committee) meeting in Frankfurt am Main on Dec. 18, 1940, by Dr. Reppe, I. G. Farbenindustrie A.-G. This translation was prepared by Mrs. I. G. Callomon and Dr. G. M. Kline, National Bureau of Standards.

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such as water, alcohols, amines, mercaptans and carboxylic acids, on the other hand, can be realized in stoichiometric proportions with metallic carbonyls as well as purely catalytically.

When the reaction is conducted in stoichiometric proportions with metallic carbonyls as CO-carrier, the presence of acids or halogens is necessary to bind the metal of the carbonyl as a salt. The mechanism of the process can be understood from the following diagram, which demonstrates the reactions carried out with the help of nickel carbonyl:

$$H_2O + C_2H_2 + {}^1/_4Ni(CO)_4 + {}^1/_2HCl\ aq. \rightarrow \underset{\text{acrylic acid}}{H_2C{=}CH{-}COOH} + {}^1/_4NiCl_2\ aq. + {}^1/_4H_2$$

$$ROH + C_2H_2 + {}^1/_4Ni(CO)_4 + {}^1/_2HCl\ aq. \rightarrow \underset{\text{acrylic ester}}{H_2C{=}CH{-}COOR} + {}^1/_4NiCl_2\ aq. + {}^1/_4H_2$$

$$RSH + C_2H_2 + {}^1/_4\ Ni(CO)_4 + {}^1/_2\ HCl\ aq. \rightarrow \underset{\text{acrylic thioester}}{H_2C{=}CH{-}COSR} + {}^1/_4\ NiCl_2\ aq. + {}^1/_4\ H_2$$

Nickel carbonyl is the most suitable of the carbonyls. Cobalt carbonyl gives similar results but is more difficult to obtain. Unfortunately, the reaction completely fails to work with iron carbonyl alone; mixed with nickel carbonyl, iron carbonyl enters only in part into the reaction. To form salts from the nickel contained in nickel carbonyl, acetic, hydrohalide and phosphoric acids are best suited. They are preferably used in aqueous solutions. If one attempts to produce acrylic esters from nickel carbonyl, alcohol and acids without water, a considerable formation of propionic esters occurs through the hydrogenating action of the hydrogen which is formed during the reaction. Strangely enough this does not occur in the presence of water, but so far we have not succeeded in finding out what happens to the hydrogen.

In production it is preferred to use the ordinary concentrated (36 percent) hydrochloric acid. Even at very moderate temperatures (40 to 42° C.), the reaction proceeds extremely violently with practically quantitative yields of acrylic acid derivatives (esters, amides, thioesters, etc., besides a little free acid). It is remarkable that these reactions, which proceed so easily, had never before been observed, although all the necessary equipment is at hand in any primitively equipped laboratory.

For the production of ethyl acrylate according to this method, one only has to mix alcohol with concentrated hydrochloric acid in a three-necked stirring flask, displace the air with acetylene and add the necessary amount of nickel carbonyl dropwise from a burette at 40 to 42° C. Care must be taken to keep adding enough acetylene into the reaction vessel to prevent a vacuum from developing due to the extremely violent acetylene absorption. After distilling the ester-alcohol mixture from the nickel chloride, the pure acrylic ester is obtained in the usual way by washing with water and distillation.

We have found that regeneration of nickel carbonyl from the residual nickel chloride can be accomplished in a simple way. First, to the nickel chloride solution is added slightly more ammonia than is necessary for the formation of the complex hexamine-nickel-2-chloride; then it is treated with carbon monoxide at about 80° C. and 50 to 100 atmospheres pressure. In this way nickel carbonyl is formed quantitatively, while the aqueous solution on top contains ammonium chloride and ammonium carbonate besides the excess ammonia. When the aqueous phase is treated with milk of lime, the free ammonia and that bound in the form of salts is regenerated and introduced again into the process. This simple conversion of nickel salts into nickel carbonyl in aqueous solution which can be carried out continuously and directly in packed towers, was not known heretofore. Compared with the old metallurgical method—precipitation of the nickel chloride solution with soda, filtration, drying, heating in a muffle furnace, and converting the dry oxide with carbon monoxide in a discontinuous process into nickel carbonyl—this represents an enormous technical advance.

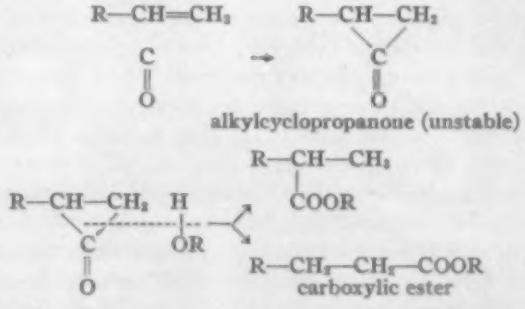
The acrylic ester synthesis, according to the described stoichiometric method, from nickel carbonyl, concentrated hydrochloric acid solution and alcohol can be carried out continuously in a tower system. The method works without pressure.

The extremely smooth course of the reaction without pressure and at low temperature in combination with high yields of acrylic acid derivatives and ease of regeneration of the nickel carbonyl makes the process appear very promising for much lower production costs as compared with the present method. A semi-commercial plant for producing 30 to 50 t/mo of acrylic ester is being constructed in Ludwigshafen.

We naturally also endeavored to carry out the newly discovered reaction catalytically. This reaction proved to be quite feasible.

Metallic nickel or cobalt are suitable as catalysts, but their salts are better, especially the halides and sulfites. Nickel iodide is the most active and is most effective in combination with metallic nickel as well as other activators. The catalytic process, which works at 120 to 150° C., requires the use of pressure. In discontinuous production in autoclaves, the catalytic conversion to acrylic esters proceeds perfectly. The continuous production is, at present, still in the preliminary stage; there are some difficulties with regard to the life of the catalysts. But, on the other hand, the formation of acrylic amides according to the catalytic method is more advanced. Here, the catalysts show longer life, so that there are prospects that in case a larger demand for acrylic amides should arise, this method could be soon applied on a commercial scale.

Naturally, on the basis of our experiences with the acetylenes, we immediately proceeded to apply the newly found reaction to the olefins. It could be expected that in this case the carbon monoxide would, first, become attached to the double bond of the olefins with the intermediate formation of the hypothetical cyclopropanone ring; thereupon, in the presence of an acceptor with a labile hydrogen atom—i.e., water, alcohols, amines, mercaptans, etc.—the cyclopropanone ring would split into aliphatic carboxylic acids or their esters, amides, thioesters, etc. On the basis of this theory, the expected reactions could be realized as demonstrated by the following equations:



As the equations show, in agreement with the actual findings, the splitting of the cyclopropanone ring occurs in both possible directions and both straight chain products and alpha-methyl-substituted reaction products (carboxylic acids or their derivatives) are formed in almost equal proportions. The various reactions possible (*Please turn to page 210*)

Survey of Adhesives and Adhesion*

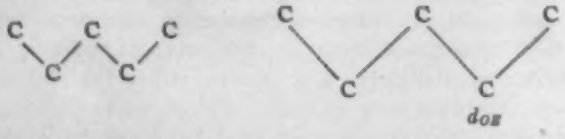
Part II. Properties of Adhesively Bonded Structures

by R. C. RINKER and G. M. KLINE†

IT has been previously shown that high polymers consist of a weblike distribution of molecules which, in addition to being mechanically intertwined, are attracted to one another by forces ranging from weak van der Waals forces to strong chemical bonds. Any high polymer at a given temperature will, consequently, be either rigid or soft, depending on the magnitude of these bonds. There is a definite temperature for each substance below which it is appreciably more rigid than it is above that temperature. This point is known as the transition point and is a characteristic of materials bonded by van der Waals forces.

When a high polymer is placed under a given stress it will suffer a deformation, the extent of which depends on the temperature and the amount and rate of loading. The deformation may be resolved into three components.[34]

1. Ordinary Elastic Deformation (d_{OE}). The individual links in the chain molecule may be stretched by altering the bond angle under an applied load.



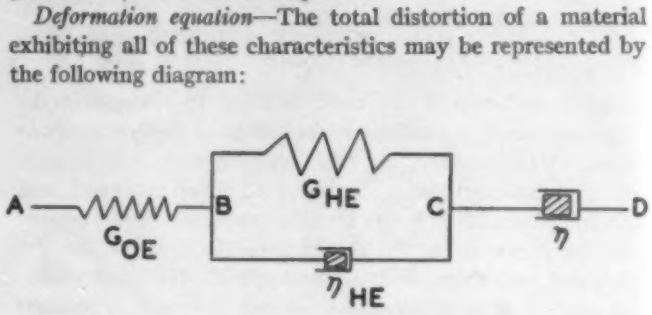
The forces required to bring about such a strain are very high, being of the order of Young's modulus for metals. We may thus define a modulus of elasticity (G_{OE}) for this process which has a magnitude of 10^4 to 10^6 kg./cm.^{2} Such a deformation will appear or vanish immediately as the load is applied or released. It is completely independent of temperature.

2. Highly Elastic Deformation (d_{HE}). A chain molecule has considerable length with respect to molecular dimensions, and the single covalent bonds do not prevent free rotation of the atoms in the chain. Consequently, the maximum possible distance between ends of a carbon chain is never reached in equilibrium. It seems most likely that the chain is more or less coiled along its entire length and the distance between ends will have a definite range for a given kinetic energy of the molecule. In order to increase the distance between the ends of these molecules it is necessary that a distorting load be sufficient to uncoil the chain. In addition to the energy required for uncoiling, some energy must be expended in overcoming the attractions between points along the chain and similar points on neighboring molecules. This latter effect accounts for this process being temperature dependent.

The modulus of elasticity (G_{HE}) for a material which may be distorted by this process is of the order of 10 to 100 kilograms per square centimeter and very great distortions are obtained; rubber, for example, may be extended 1000 percent. Once the load is removed the coiling process will begin, but requires time to reach equilibrium. This equilibrium is attained by simple revolution of the atoms about the single bonds and by overcoming attractive neighboring forces which retard the process.

3. Viscous Deformation ($d_{visc.}$). Above the transition temperature a thermoplastic material will be principally distorted by separation of the molecular chains. This means that the kinetic energy of chain motion is sufficient to overcome the van der Waals side forces, thus allowing the molecules to be drawn along each other without a greatly retarding friction. This process is also time dependent, the rate of flow depending on the difference between the experimental temperature and the transition point.

Deformation equation—The total distortion of a material exhibiting all of these characteristics may be represented by the following diagram:



Each element in the diagram will be displaced to an extent dependent on the load. The increase in distance between A and D under a given load is the total distortion for that load. Thus this may be written:

d_{OE} = increase in distance AB
d_{HE} = increase in distance BC
$d_{visc.}$ = increase in distance CD

This process has been represented mathematically by Alexandrov and Lazurkin[35] and has been modified by Simha[36] as follows:

$$D(t) = d_{OE} + d_{HE}(\infty)\left[1 - \exp\left(-\frac{t}{\lambda}\right) + \frac{t\tau}{\eta}\right] \quad (1)$$

The total deformation (D) is expressed as a function of rate of loading, and as the sum of the three types of deformation already discussed. The significance of each of these elements is as follows:

1. *Ordinary elasticity*—

$$d_{OE} = \text{ordinary elastic deformation} = \frac{\tau}{G_{OE}}$$

where:

G_{OE} = ordinary shear, tension or compression modulus of elasticity
τ = stress.

2. *High Elasticity*—

$$d_{HE}(\infty) = \text{ultimate high elastic deformation} = \frac{\tau}{G_{HE}}$$

where:

G_{HE} = modulus of high elasticity.

This factor is modified by the exponential term which ex-

* National Advisory Committee for Aeronautics, Technical Note No. 980.
† National Bureau of Standards.

presses the dependency on rate of loading and the viscous element.

t = time elapsed between start of loading and the instant of observation, rate of loading being constant

$\lambda = \frac{\eta_{HE}}{G_{HE}}$

η_{HE} = the viscous effect associated with the highly elastic deformation.

3. *Viscosity.* The final term expresses the deformation brought about by the viscous flow of the material modified by the rate of loading.

This equation for the deformation of high polymers is only a first approximation. Other expressions have been developed, based on thermodynamics, which involve considerations of crystallization phenomena. It is expected that further developments in the interpretation of mechanical behavior of high polymers will materially contribute to a better understanding of glue-line phenomena.

Effect of Thickness of Glue Line on Strength

Experimental evidence—An investigation of several adhesives for wood by Poletika[37] reveals that joint strength is inversely proportional to the thickness of the glue line. However, starved joint formation will occur if too little adhesive is applied to porous surfaces and would result in a weak joint because of lack of film continuity.

Glue layer thickness	*Number of samples*	*Average shear strength*	*Average wood failure*
inch		*p.s.i.*	*percent*
0.002	5	1500	37
0.003	5	1330	40
0.004	11	1450	25
0.005	17	1410	22
0.006	6	1340	21
0.007	7	1150	29
0.008	8	1100	19
0.009	10	1180	11
0.010	9	1200	9
0.011	6	900	12
0.012	7	940	11
0.013	7	920	6
0.014	4	840	4
0.015	5	850	4
0.016	3	670	5
0.017	4	790	3
0.018	4	480	2
0.019	2	560	5
0.020	1	520	3

Similar relationships were found by Crow[39] in a study of soft soldered joints. He found that, by making the film very thin, joint strengths as high as 11 tons per square inch were obtainable. This value is several times the tensile strength of the solder.

Probability of flaws—The relationship between average strength and rod or fiber length has been discussed by Peirce[40] for cotton, Bellinson[41] for rayon, and Anderegg[42] for glass. If a fiber 10 in. in length is broken, the rupture will occur at the weakest spot. If another fiber exactly like the first is divided into ten 1-in. lengths and each of these is broken, a range of breaking loads will be obtained, the lowest being equal to the one obtained on the first fiber. Thus the shorter the specimen the less will be the probability that it will contain the weakest spot. This same analogy can be applied to glued joints: the average strength of ten thin ones should be greater than that of one ten times as thick.

To test this assumption, Bikerman[38] prepared joints between brass blocks and steel cylinders with paraffin wax. He controlled the thickness of the wax film in each joint so that 100 joints were obtained having thicknesses of approximately 57 μ, and 40 of approximately 540 μ. The operational variables were minimized by preparing 10 thin joints and 4 thick joints in ten successive groups. The tensile load was applied by suspending gram weights from the samples. The results of these tests are as follows:

Group of specimens	*Strength of paraffin wax joints*			
	57 μ			*540 μ*
	Maximum	*Mean*	*Minimum*	*Mean*
	kg./cm.²	*kg./cm.²*	*kg./cm.²*	*kg./cm.²*
1	35.0	27.5	18.0	17.5
2	35.0	29.5	20.0	15.5
3	32.0	26.0	20.5	16.5
4	31.0	25.0	18.5	14.5
5	25.5	22.0	17.0	13.0
6	32.0	24.5	19.5	18.0
7	28.0	22.5	14.5	13.0
8	29.5	23.5	20.5	13.0
9	28.5	23.0	16.5	14.5
10	29.5	22.5	17.0	13.0
Ave.	30.6	24.6	18.20	14.85

The average value obtained for the thin joints compares with the value of 18 kilograms per square centimeter for paraffin to brass obtained by McBain and Lee.[14] The tensile strength of paraffin measured by Konstantinova[43] is 7.45 kilograms per square centimeter and for joints thinner than 0.01 millimeter, 14.8 kilograms per square centimeter. McBain and Lee obtained the following values for varying thicknesses of shellac joints; these show similar relationships to Bikerman's values:

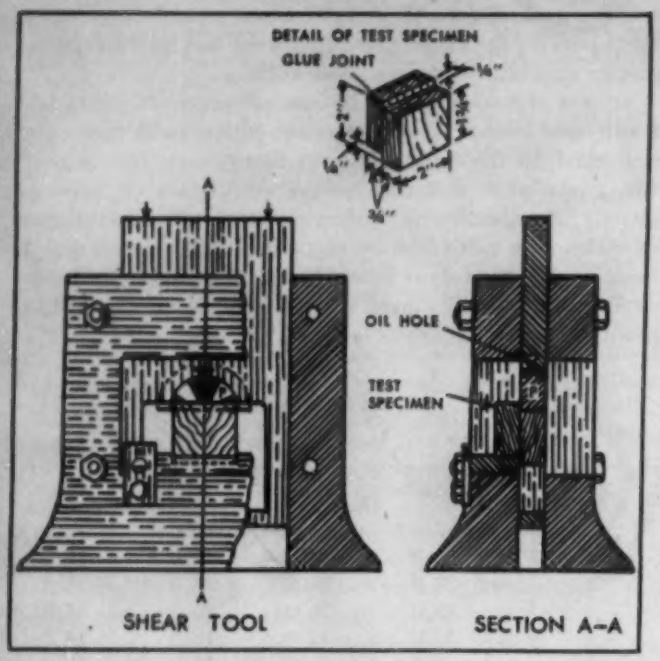
Joint	*Strength of joints*		
	Thin 57 μ	*Thick 540 μ*	*Ratio Thin/Thick*
	kg./cm.²	*kg./cm.²*	*kg./cm.²*
Al:shellac:Al	145.0	75.0	1.93
Ni:shellac:Al	190.0	110.0	1.73
Brass:paraffin:steel	24.6	14.8	1.67

Bikerman analyzed his data by means of a simple application of probability theory as follows:

Let m = number of specimens of length l
n = number of specimens of length l/n

Assuming that the probability of finding a weak spot is a function of length, one in n of the thin joints will contain the weak spot which would have caused the failure of the thick joint. The tensile strength of this joint would accordingly be identical with that of the thick joint. If this reasoning is correct, the low values in each batch of the paraffin joints of 57 μ thickness should not differ significantly from the average values of those of 540 μ thickness.

The difference between the low values of the thin joints and the average values of the thick joints were found to be significant, but the probability theory accounts for approx-



6—Block shear specimen and tool. (From ANC-19)

imately two-thirds of the difference in strength. This is shown as follows:

Let m = number of values
t = a measure of the significance of the difference
$x_1, x_2, x_3 \ldots x_{10}$ = the differences in the same group between the minimum values of the thin joints and the average values of the thick joints

and x = the difference between the total averages for the minimum values of the thin joints and the average values of the thick joints.

Then $m = 10$

$$x = 18.20 - 14.85 = 3.35$$

and $$t = x\sqrt{m(m-1)}/[(x_1 - x)^2 + (x_2 - x)^2 + \ldots + (x_{10} - x)^2]^{1/2}$$

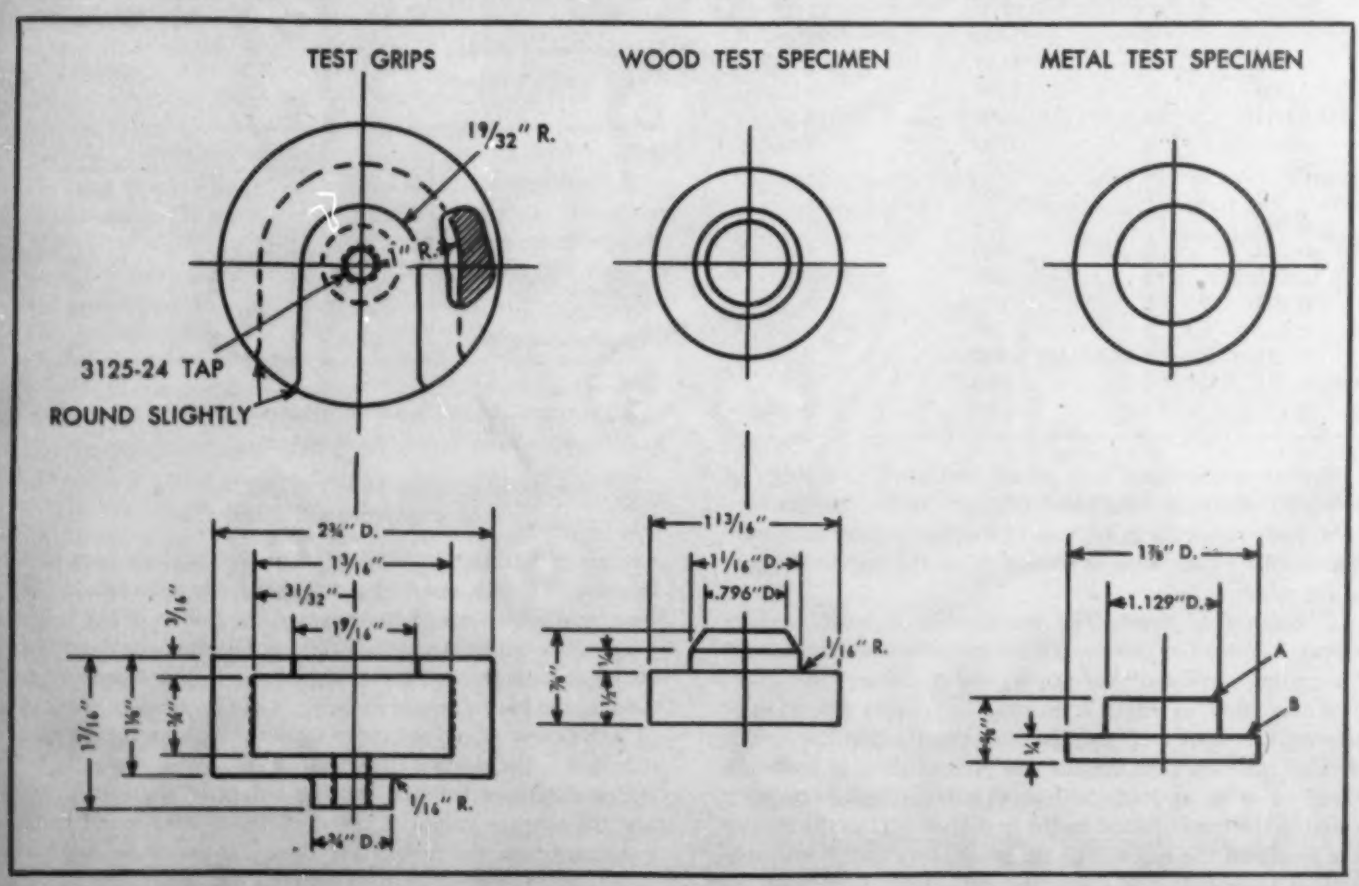
$$= 5.1$$

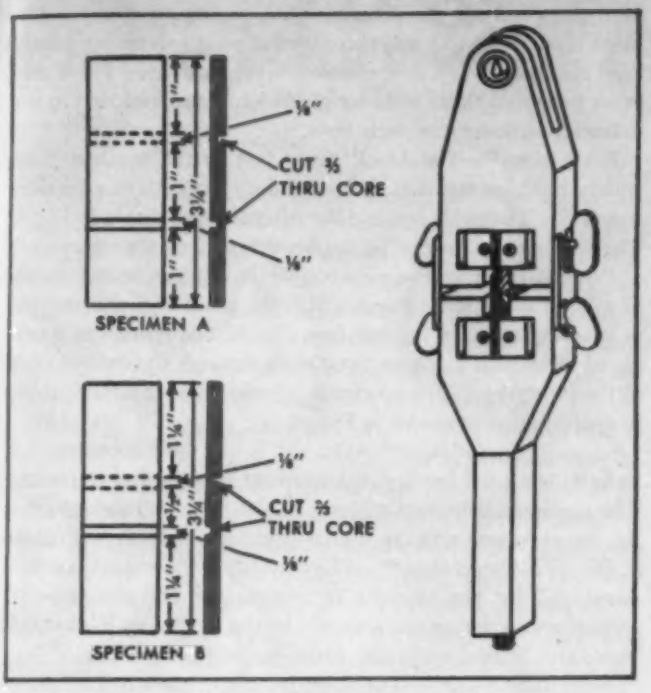
Since, when $m = 10$, only one value of t in 100 will exceed 3.25 by chance, the difference between the low values for the thin joints and the average values of the thick joints is significant. The discrepancy between these values is explained by Bikerman as due to crystallization differences in the thick and thin sections of wax.

Surface smoothness—In order to obtain a strong joint, a smooth surface is more desirable than a roughened one, inasmuch as the depressions in the latter must be filled in addition to the gap between the two surfaces. Furthermore, if the surface is deeply scored, there is always a possibility that air bubbles will be trapped in the glue line. The existence of such points of interfacial discontinuity will cause high concentrations of stresses in their vicinity which will result in premature failure of the entire bond when external loads are applied.

Effect of curing conditions—When a thermosetting resin adhesive is used, it is cured in the joint with pressure and very frequently with heat. Thus it reaches an equilibrium state under an abnormal set of conditions. When the pressure and heat are released, the resin has a tendency to reach an equilibrium at a lower pressure and temperature, but is restrained by its bond to two surfaces. This results in a stress at the glue line. If the glue line is very thin, these stresses will be

7—Tensile test specimen. (From Platow, Reference 46.) Test grips, left. Wood specimen, center. Metal specimen, right





8—*Plywood shear specimens and grips. (From ANC-19)*

very small with respect to the bond strength and the glued joint will be able to support much higher loads. Similar stresses are set up in adhesive films which are formed by evaporation of solvent.

Problem of Thermal Expansion Differences

Inorganic materials such as glass and metals are characterized by relatively low coefficients of thermal expansion, whereas organic materials in general have high thermal expansion coefficients. Hence stresses are developed in joints prepared with these two types of materials when the temperature differs appreciably from that at which the bond was formed. If the molecular cohesion of one of the materials is sufficiently low, the stresses developed at the glue line can be relieved by flow. However, such materials usually undergo excessive flow at temperatures above the softening point and have poor bond strengths. For materials which have high molecular cohesion and hence undergo very little flow, such as the thermosetting resins or most materials at low temperatures, the stresses developed because of different thermal expansion coefficients are not readily relieved by molecular flow.

For the latter type of material it is necessary to add an ingredient to the adhesive to adjust its thermal expansion coefficient to approximately that of the adherend. Investigations at the National Bureau of Standards[44] have shown that this can be achieved by the addition of inorganic powdered materials to the adhesives. This may be illustrated by the adjustment of the thermal expansion coefficient of polystyrene to that of brass.

Pure polystyrene has a thermal expansion of 70×10^{-6}/° C. whereas that of brass is 17×10^{-6}/° C. When brass inserts are placed in pure polystyrene, very small changes in temperature cause the plastic to crack and become detached from the metal. If 11 percent aluminum oxide, having an expansion coefficient of 8.7×10^{-6}/° C., is added to the polystyrene, cracking does not occur over a wide temperature range and the bond remains intact.

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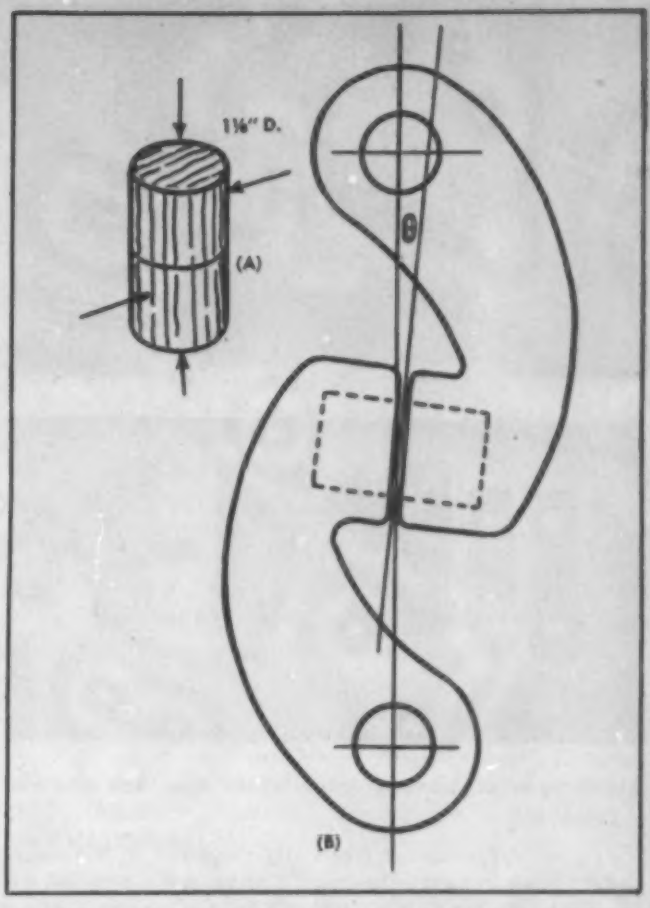
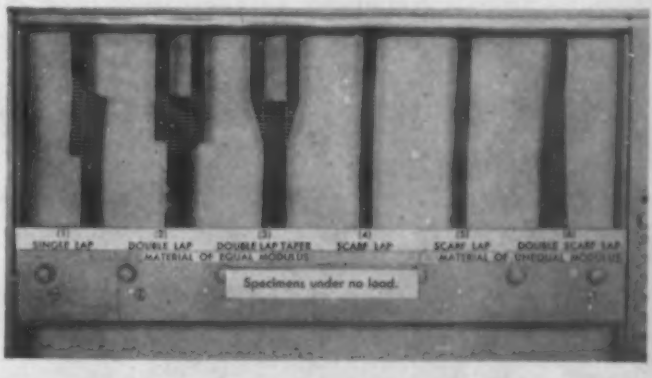
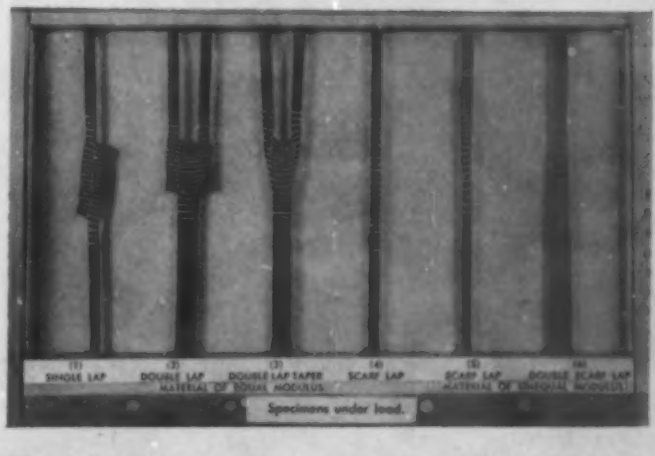
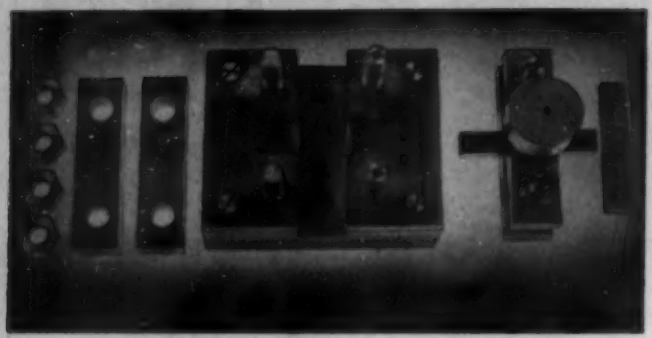


9—*This is a drawing of a cylindrical single shear specimen and grips. (From McBain)*





10—*Distribution of stresses in shear test specimens: Top, no load; bottom, loaded specimens. (From Jackson)*



11—*Pictures of Johnson double shear specimen and tool*

This same principle is frequently employed in the use of carbon black in rigid adhesives. Carbon has a very low expansion coefficient (5.4×10^{-6}). When 10 percent is added to phenol-formaldehyde resin, the coefficient of expansion is 20 percent less than that of the pure resin. Equations for calculating the composition of adhesive mixtures required to obtain a desired thermal expansion coefficient are given in references 44 and 45.

Test Methods for Bond Strengths

Comparatively little work has been done on the development and standardization of testing methods for determining the fundamental physical properties of adhesively bonded joints. The American Society for Testing Materials has recently organized Committee D-14 on Adhesives to formulate methods of tests pertaining to adhesives. The cooperative efforts of the members of this committee should contribute to a better understanding of the problems involved in testing adhesively bonded joints and should provide a basis for obtaining uniform test data for bonds formed between the many available varieties of adhesives and adherends.

Some of the testing methods which have been used or proposed for the determination of bond strengths will be briefly reviewed to complete this survey on adhesives and adhesion.

Tensile strength

A method for the determination of the tensile strength of glued joints based on experimental work at the Bell Telephone Laboratories[46] has been prepared for consideration by the Subcommittee on Strength Properties of A.S.T.M. Committee D-14 on Adhesives. This method provides for the type of specimen shown in Fig. 7 and specifies that self-aligning grips shall be employed in order to assure loading exactly normal to the glued surfaces.

Shear tests

In the testing of glued joints in shear it is very difficult to attain pure shear conditions. A variety of methods have been proposed for the determination of this property. The block shear joint test and the plywood joint test are currently used in Army-Navy Aeronautical specifications. These and other proposed shear tests for glued joints are included in the following summary of such tests.

Block shear[47]—The block shear test is the method most widely used for evaluating the bonding strength of adhesives to wood. The specimen and shearing tool are shown in Fig. 6. The specimen is broken by application of a compressive load.

Plywood shear[47]—The plywood shear test specimen consists of a 3-ply wood laminate in which the grain of the center ply is at right angles to the two face plies. The specimen is prepared by milling a groove two-thirds through the core on each of the face plies. The specimen is broken under a tensile load in special grips as shown in Fig. 8.

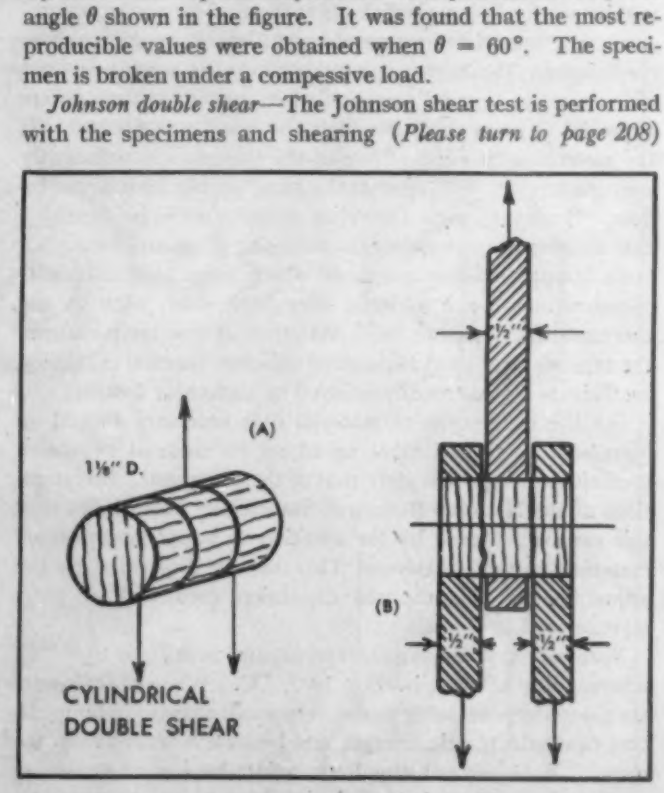
Single lap joint shear[48]—The single lap joint specimen has been widely used for the measurement of adhesion to metals. The specimen is broken under a tensile load. Standard grips for tensile specimens are used. Specimen shown in Fig. 10.

Double lap joint shear[48]—The double lap joint specimen was developed for the purpose of overcoming the unequal distribution of stresses encountered in the single lap joint specimen, and is broken in the same manner. (See Fig. 10.)

Scarf joint shear[48]—The scarf joint specimen is difficult to prepare, but the shearing stresses developed in the glue line are more uniform than for any other type of shear test. If the two adherends are of equal modulus, the single scarf joint is adequate. For materials of unequal modulus, however, it is necessary that the angle taper of each be proportional to its modulus, thus necessitating a double scarf joint. These joints are illustrated in Fig. 10. The specimens are broken under a tensile load.

Cylindrical single shear[14]—The cylindrical single shear test was used by McBain to reduce the amount of wood failure in the glue line. The grips and specimen are shown in Fig. 9. By means of a special adjustment it is possible to vary the angle θ shown in the figure. It was found that the most reproducible values were obtained when $\theta = 60°$. The specimen is broken under a compessive load.

Johnson double shear—The Johnson shear test is performed with the specimens and shearing (*Please turn to page 208*)



12—*These two drawings show a cylindrical double shear specimen and grips. (From McBain)*

Plasticizing with ethylhexyl phthalate

CLOSE in importance to the resins themselves in the production of elastomeric plastics is a liquid chemical that appeared four years ago on the shelves of only a few laboratories. Introduced to industry in late 1940, di-2-ethylhexyl phthalate, more commonly known as "Flexol" plasticizer DOP or dioctyl phthalate, is extremely important to the production of electrical cable insulations, cloth coatings and various military uses of plastics and elastomers.

It is not surprising that dioctyl phthalate has become so important, for its properties represent a most favorable balance of the requirements for a plasticizer. It is a light-colored, non-volatile, water-insoluble liquid that is miscible with hydrocarbons and most organic solvents. Plasticizer DOP can be used to plasticize vinyl resins, such as the vinyl chloride, vinyl chloride-acetate, vinyl butyral and the vinylidene chloride type resins, as well as cellulose nitrate, ethyl cellulose and cellulose acetate butyrate and, to some extent, polyvinyl butyral resins, polymethyl methacrylate and the phenolic resins. It has also been employed as a softener for Buna N (butadiene-acrylonitrile), Neoprene and Buna S synthetic rubbers.

The development and commercial introduction of dioctyl phthalate was a result of an intensive plasticizer program carried out by Carbide and Carbon Chemicals Corporation. Ethylhexanol, the alcohol from which this plasticizer is made, has been available in limited commercial quantities since 1933, but its use in the manufacture of plasticizers did not begin until about five years ago, when its industrial importance reached the point of requiring larger production facilities. Now with large scale production of plasticizer DOP, the cost of the ester has been brought well within an economically practicable range.

Plasticizers were originally viewed only in terms of their faculty for improving the flexibility of a resin. It was soon found, however, that many more considerations were mandatory, and that, with the proper plasticizer in the correct amount, not only plasticity but other characteristics as well could be enhanced in a plasticizer-and-resin composition. In fact, since it could affect so many properties, the correct plasticizer was defined as the material that imparted the greatest of benefit to a given resin for a given purpose.

In addition to good softening properties, a successful plasticizer must possess low volatility, compatibility and chemical stability, since all these properties have a direct bearing on the permanence of the compounded resin. Heat and light stability, flammability, odor, taste, color, resistance to extraction, flexibility at low temperatures and electrical insulating characteristics—all these factors vary in importance depending on the intended application of the plasticized compound, but all must be considered.

Compatibility

To be suitable for use in a resin, a plasticizer must be adequately compatible with that resin. That is, it should be compatible to the extent that it can be incorporated in the resin in sufficient quantities to plasticize the resin effectively without sweating out. Table I shows the compatibility of dioctyl phthalate with some of the common commercial resins and plastics.

The subject of compatibility is an involved one since liquids that seem quite compatible at one temperature or when first used may later exude at room temperature, in a freezing chamber, or when subjected to high humidities. In these respects dioctyl phthalate is, for the most part, satisfactory. Only rarely has it been known to sweat out from compounds in which it was thought to be compatible, even upon long standing or when the compound is immersed in water.

It should not be concluded from the foregoing remarks, however, that limited compatibility of a plasticizer with a resin precludes the use of that plasticizer. If more than one plasticizer is used, the second can often be chosen as a coupling agent to permit greater compatibility and to influence the first. For example, it may be possible to use a relatively high proportion of dioctyl phthalate in cellulose acetate if another plasticizer, compatible with both, is introduced as a coupler.

Chemical and heat stability

The stability of a plasticizer to heat, light and oxygen, and to the action of the plastic and other compounding materials must frequently be considered. Instability of a plasticizer may result in embrittlement, discoloration or the development of objectionable odor in the plasticized composition.

These samples of vinyl chloride-acetate resin sheeting contain plasticizer DOP in varying amounts. The stiff sample (top) contains 15 percent plasticizer and each succeeding strip has 5 percent added until, with 40 percent plasticizer (bottom) the sheet is limp and pliable

PHOTO, COURTESY CARBIDE AND CARBON CHEMICALS CO.

TABLE I.—COMPATIBILITY OF "FLEXOL" PLASTICIZER DOP WITH VARIOUS PLASTICS

Plastic	*Ratio of plasticizer to plastic*[a] *1:4*	*1:9*
Cellulose acetate	I	I
Cellulose acetate butyrate	S I (W)	C
Cellulose acetate propionate	Cl (W)	Cl (W)
Cellulose nitrate (1/2 sec. R.S.)	C	C
Ethyl cellulose (low viscosity)	C	C
Methyl methacrylate resin	C	C
Vinyl acetate resin (medium molecular weight)	I	SI
Vinyl butyral resin	Cl	C
Vinyl chloride resin	C	C
Vinyl chloride-acetate resin (medium molecular weight)	C	C
Vinyl chloride-acetate resin (high molecular weight)	C	C
Vinylidene chloride-vinyl chloride resin	...	C

[a] C—Compatible
I—Incompatible
S—Slightly
Cl—Film clear, but plasticizer sweats out
W—Film weak

Plasticizer DOP is a stable liquid retaining its influence with a minimum of change over extended periods of time.

Low volatility

The importance of the volatility of plasticizers varies with the type of resin compound. As can be expected, this characteristic is most pertinent in the case of non-rigid plastics, which depend entirely on an added plasticizer for their flexibility. In rigid plastic compounds it is sometimes permissible to use a plasticizer with relatively high volatility, such as dimethyl phthalate, although warping and embrittlement may result.

Many factors influence the rate of loss due to volatility. These include temperature, amount of ventilation, compatibility and the thickness of part exposed. Thus, it is impossible to specify the permissible limits of volatility. For these same reasons, it is understandable why those plasticizers having relatively low volatility, such as dioctyl phthalate, have become so popular. One of the outstanding characteristics of dioctyl phthalate which has been mentioned previously is its low volatility at room temperature. Its evaporation rate even at 190° C. is only 15 mg. per sq. cm. per hr.—far lower than that of dibutyl phthalate which is 148 mg. per sq. cm. per hr. at 190° C. The boiling point of dioctyl phthalate at a pressure of 5 mm. of mercury is 229° C.

Water solubility

Plastics are frequently exposed to water or oils that may extract some of the plasticizer and thus result in a harder, stiffer product. It is advantageous, therefore, if the plasticizer is insoluble in the extracting liquid.

TABLE II—EFFECT OF WATER AND OIL ON MIXTURES OF VINYL CHLORIDE-ACETATE RESIN AND DOP PLASTICIZER

"Flexol" plasticizer DOP in resin	*"Flexol" plasticizer DOP lost in 10 days from 0.004-in. film at 25° C.* *Water*	*Oil*
% by wt.	%	%
30	0.3	5.3
33.5	0.3	8.2
35	0.2	10.0
40	0.2	16.5

Plasticizers having very low water solubility are as a rule less readily extracted by water. Water dissolves less than 0.01 percent by weight of dioctyl phthalate at 20° C. Plasticizer DOP is not recommended for highly plasticized compounds requiring a maximum of oil resistance, although it is more resistant to oil extraction than many commercial plasticizers. Table II shows the effects of water and oil on mixtures of vinyl chloride-acetate resin and this plasticizer.

Flexibility at low temperatures

Low-temperature flexibility continues to present a problem for plastics engineers. In this connection a fairly general rule is that the lower the freezing point of the plasticizer and the less tendency it has to increase in viscosity at low temperatures, the more desirable it is as a low-temperature plasticizer. Although dioctyl phthalate does not crystallize at low temperatures, it does increase in viscosity as the temperature is lowered. It contributes good low-temperature flexibility to plastic and synthetic rubber compositions.

Electrical properties

In most insulating compounds, plasticizers must be chosen with a view to maintaining as high an electrical resistivity as possible. In the field of ester plasticizers, plasticizer DOP is outstanding electrically, since its power and loss factors and dielectric constant are low and its d.c. resistivity is high. Its corrosive effect on copper is nil even under severe service conditions. This property and the plasticizer's good electrical characteristics make it particularly useful as a plasticizer in wire insulation and cable-coating compositions.

Non-flammability

Unfortunately, compositions containing certain flame-resistant resins become flammable when combined with large quantities of a flammable plasticizer. Consequently, the relative flammability of the plasticizer is of utmost importance. While dioctyl phthalate, like all organic chemicals consisting solely of carbon, hydrogen and oxygen, is flammable, its temperature range of flammability is comparatively high. It has a flash point of 217° C. and a fire point of 238° C. The use of one-third tricresyl phosphate and two-thirds plasticizer DOP in highly plasticized stock is recommended where non-flammability is desirable. However, in a film 0.020 in. thick, containing up to 20 percent plasticizer, dioctyl phthalate can be used without inducing flammability. Thicker films can contain larger percentages and remain non-flammable.

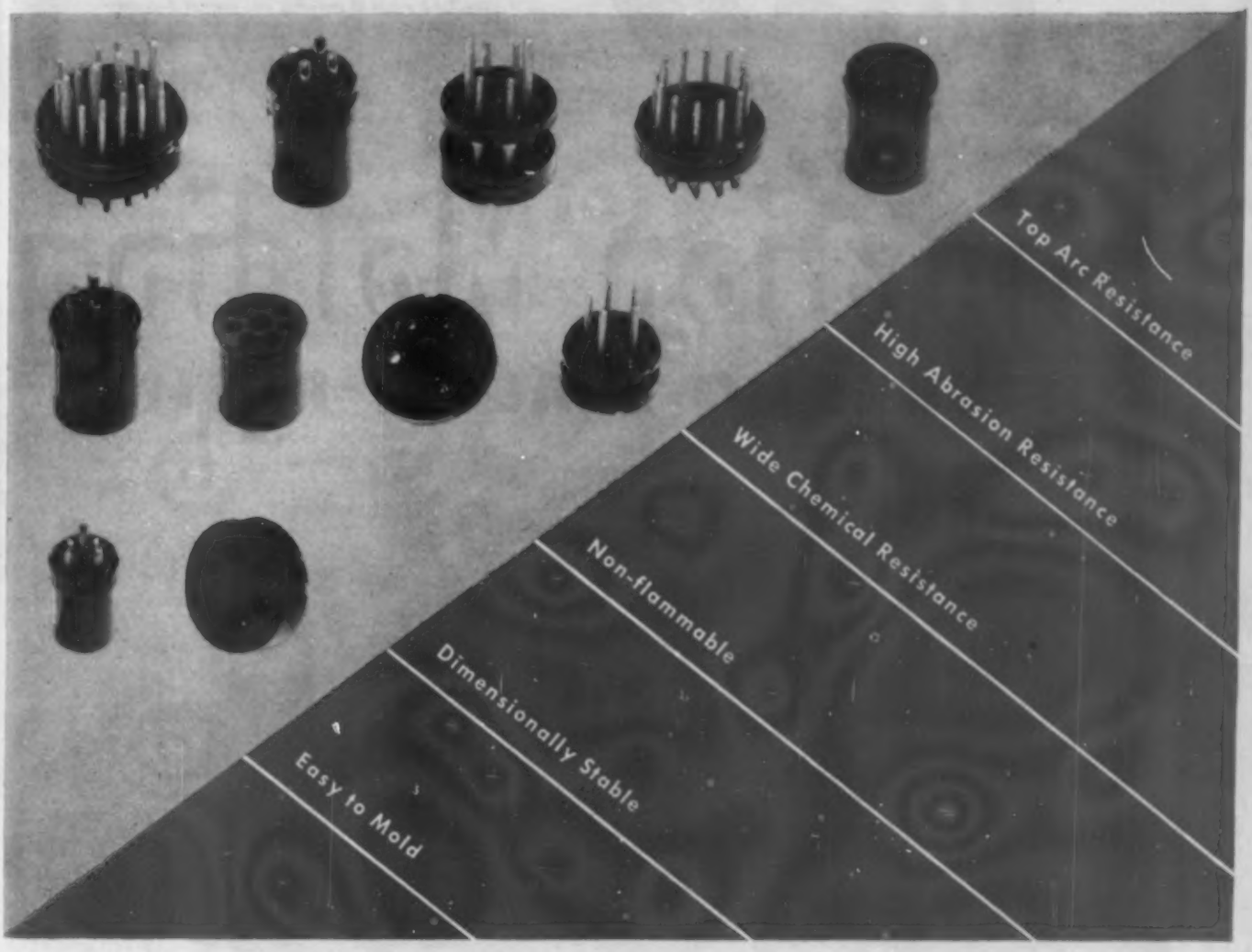
Odor, taste and toxicity

The properties of odor, taste and toxicity are important in a plasticizer, particularly when it is to be used in plastics for food containers and surgical appliances. Plasticizer DOP has a mild characteristic odor and taste. The toxicity of the phthalate esters has been found to decrease with increasing molecular weight of the alkyl component. In extended tests using dioctyl phthalate on rats and mice, this plasticizer is reported to have a very low order of toxicity, definitely lower than that of other phthalates and plasticizers such as tricresyl phosphate, used for similar applications.

Use with various resins

"Flexol" plasticizer DOP is an excellent plasticizer for the vinyl chloride-acetate resins and vinyl chloride resins but its usefulness is by no means con- (*Please turn to page 206*)

RESIMENE* 803A



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But that is not all Resimene 803A offers . . . its abrasion resistance is higher than cellulose filled phenolic . . . it has higher alkali resistance than most thermosetting plastics and, in addition, it's not attacked by weak acids, most organic solvents or boiling water. These properties are combined in a molding compound of excellent moldability and good physical properties formerly expected only with general purpose phenolics. After-shrinkage of Resimene 803A is considerably less than any similar material . . . Resimene 803A is being produced only in black and olive drab.

* * *

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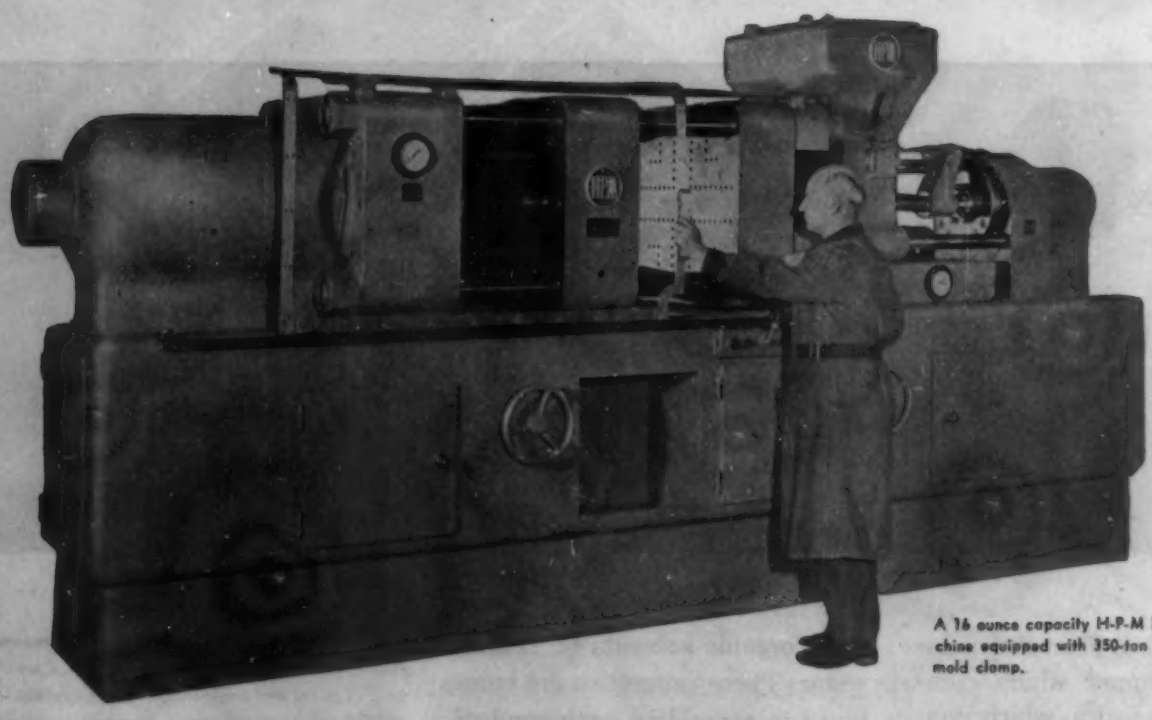

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PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

PLASTICS AT WAR—A GENERAL SURVEY. N. J. L. Megson. British Plastics *17*, 230-50 (June 1945). This is a comprehensive survey of the activities of the British plastics industry during the war period. The organization and functioning of the technical advisory governmental organizations, the applications of plastics, and developments in materials are described. Some of the specific subjects considered are plastics control, contacts abroad, method of handling technical problems, raw material supply, development in specific type of plastics, advances in molding and fabricating, specifications, specific applications, German equipment, rubber substitutes, leather substitutes, research and development, mold growth, wood waste and optical plastics. 21 references.

PLASTICS IN COOPERAGE. British Plastics *17*, 264-6 (June 1945). The use of phenolic resin-bonded laminated wood and phenolic resin adhesive in the construction of a brewer's cask is described. This cask withstood severe evaluation tests.

THE CHEMISTRY OF PLASTICS. R. C. Chirnside. Gen. Elec. Co. J. *13*, 74-89 (Aug. 1944). The synthesis and properties of the various types of plastics and the raw materials used in their production are simply described.

Materials

CATALYTIC CURING OF SILICONE RESINS. H. A. Gardner and M. W. Westgate. Natl. Paint, Varnish, Lacquer Assoc., Sci. Sect., Circular No. 705 (1945). The catalytic curing of silicone resins with lead naphthenate, lead resinate and lead linoleate is described.

NEW INSOLUBILIZERS OF CASEIN AND WHEAT GLUTEN IN PREPARATION OF PLASTIC SUBSTANCES. G. A. Fester, F. A. Bertuzzi and A. Collados. Rev. facultad quím. ind. agr. (Univ. nacl. litoral, Santa Fé, Argentina) *13*, 93-8 (1944); Chem. Abstracts *39*, 2226-7 (May 20, 1945). Rennet casein and wheat gluten were impregnated with methyldiphenylamine and water, molded at 100 kg/cm^2 and hardened by immersion in various solutions. The best hardening agent for casein was trioxymethylene and sodium sulfite in water. Basic chronic sulfate and formaldehyde solutions gave the best results with gluten.

IMPROVED WOOD. I. IMPREGNATION WITH RESINS. D. Narayanamurti and K. Singh. Forest Research Inst., Dehra Dun, Indian Forest Leaflet, Utilization No. 42, 15 pp. (1943). The density and maximum crushing strength of several Indian woods which were impregnated with phenol-, cresol-, xylenol-, prolamine- and ground nut-protein-formaldehyde resins, shellac, rubber latex and cashew-shell oil by diffusion, pressure and prior displacement of the sap by a solvent are reported. Such treatments improve the properties of inferior woods.

Molding and fabricating

EXTRUDING DIES FOR CELLULOSE MATERIALS. W. O. Lawson. Tool & Die J. *10*, No. 12, 120-2 (1945). Extruding dies for cellulosic plastics are described and discussed.

HEAT IN THE MOLDING PLANT. M. Freund. British Plastics *17*, 251-54a, 262a (June 1945). The problem of heat consumption and supply in a molding plant is considered. Gas heating, electrical heating, steam heating and high-pressure hot water heating are discussed.

INFRA-RED HEATING. T. A. Roberts and G. J. Happerfield. British Plastics *17*, 302-5 (July 1945). An apparatus utilizing electrically-generated infra-red rays for preheating molding powders is described. Different types of plastics require rays of different wave lengths for the most efficient heating.

Applications

PRINTING WITH PLASTICS. R. C. Bullen. Paper Trade J. *120*, 41-42 (May 3, 1945). Plastic printing plates for the printing of newspapers have been developed that are much lighter in weight than the metal plates customarily used. A phenolic plastic matrix material is used in the production of the duplicate plate. Vinyl plastic molding compounds are employed as the duplicate plastic printing plate material because of its toughness, dimensional stability and moisture resistance. The plastic is a more faithful ink conductor and so allows for cleaner, sharper reproduction. Since the plastic (because it flows freely during molding under heat and pressure) follows the mold contours faithfully, picking up every detail, it makes a far more accurate duplicate plate than the stereotype. This results in much finer printing and more important, a considerably higher degree of fidelity in pictorial representation. This high degree of flow has made possible use of an 85-line-screen in replacement of the customary 65-line screen. Preliminary tests have been run which show the plastic printing plates to be infinitely superior to the standard stereotypes for newspaper printing. Making plastic printing plates is described.

TESTS OF SOLID FIBERBOARD BOXES MADE OF WET-STRENGTH-ENED RECLAIMED MATERIAL. K. E. Skidmore and E. C. Myers. Fibre Containers *30*, No. 4, 32, 34, 39-40, 42, 44, 49-50 (1945); Forest Products Lab., Mimeo. Bul. No. R1470 (1945). The addition of 3 percent urea-formaldehyde resin to the paper and the use of asphalt and vinyl resins as adhesives gave a box superior to those not using these materials.

PLASTIC COATINGS PROTECT CARBIDE-TIPPED TOOLS. B. Gould. Iron Age *155*, 65-6 (June 14, 1945). Carbide-tipped tools are protected during shipment and handling by covering with hot-melt dip coatings. The coatings based on ethyl cellulose are applied at 375° F. Those based on cellulose acetate butyrate are applied at 300° F.

Coatings

LAC-MELAMINE AND LAC-MELAMINE-FORMALDEHYDE RESINS. Y. Sankaranarayanan and H. K. Sen. Indian Lac Research Inst., Bul. No. 57, 5 pp. (1944). The resistance to heat, scratching and water of lac varnish films is improved by refluxing alcoholic shellac solutions with melamine. The melamine reacts with the carboxyl group of the lac molecule. When formaldehyde is added, the melamine reacts with the lac formal which produces molding powders similar to lac-formaldehyde-urea resins.

PLASTIC-PAINT TESTS. M. W. Westgate, L. P. Hart and H. A. Gardner. Natl. Paint, Varnish, Lacquer Assoc., Sci. Sect., Circ. No. 701, 16 pp. (1945). The body, hiding powers, flexibility, abrasion resistance, hardness, resistance to cold water, boiling water, 5 percent sulfuric acid, 2 percent hydroxide and 45 percent ethyl alcohol, and constituents of a number of so-called "plastic paints" were determined in an investigation made to compare these materials with the regular grades of paints, enamels, varnishes and lacquers. The results show that the "plastic paints" are in some cases as good as or slightly inferior to regular paints.

PRESENTLY AVAILABLE ORGANIC COATINGS FOR MAGNESIUM. H. E. Smith. Am. Paint J. *29*, No. 24, 54-5, 58, 60, 62, 66, 68 (1945). Organic coatings for magnesium are reviewed.

TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

A STUDY OF THE MELAMINE RESIN PROCESS FOR PRODUCING WET STRENGTH PAPER. C. G. Landes and C. S. Maxwell. Paper Trade J. *121*, 37-46 (Aug. 9, 1945). A recently developed process involving addition of a melamine resin colloid to slush paper stock provides an improved method of making wet strength paper. The process has already been adopted for the production of a wide variety of commercial papers useful in connection with war purposes where superior wet and dry strength properties are required. Laboratory studies of the peculiar changes that take place during the formation of the resin colloid have led to the development of an improved method of preparation for paper mill application. Certain paper machine operating variables are shown to have important effects on wet strength efficiency while other factors are indicated as requiring further investigation. Methods of re-use of wet strength broke are described and other special problems relating to wet strength paper are discussed. Certain special precautions must be taken in laboratory handsheet evaluations to insure reproducible results. A discussion is given of studies which relate to the fundamental mechanism of the new wet strength process. Eleven references are given in this article.

VULCANIZED FIBRE. Can. Machinery and Manu. News *56*, 68-70 (Feb. 1945). The methods of machining and punching vulcanized fibre are described.

MACHINES AND TECHNICS VARY WITH PLASTIC COATINGS. J. B. Cleaveland. Textile World *95*, 117-19, 194, 196, 198 (June 1945). The three types of machines and the technics for applying vinyl and acrylic plastic coatings to fabrics are described. The three types are (1) the knife spreader, (2) the roll coater and (3) the coating calender.

Chemistry

EFFECT OF ESTERIFICATION OF PULP FIBERS UPON STRENGTH PROPERTIES, HYGROSCOPICITY, AND HYGROEXPANSIVITY OF PAPER. J. J. Harrison. Paper Trade J. *119*, 28-38 (Aug. 3, 1944). The effects of partial acetylation, butyrylation and stearylation of Mitscherlich pulp on the properties of papers prepared from the products were investigated. It was found that the antibonding effect of the ester groups increased with the length of their carbon chain and that a lower degree of substitution sufficed to bring about the same changes as observed with acetylated cellulose of a higher degree of substitution. Likewise, the hygroscopicity and hygroexpansivity of the sheets, both being a function of the availability of free hydroxyl groups, were considerably reduced with increasing degree of substitution and increasing length of the acyl carbon chain. A fair proportion of the physical strength properties are retained by the sheets if acetone (in which the esterified fibers swelled but did not dissolve), instead of water, is chosen as a beating and sheet forming medium for the acetylated materials and for the butyrylated fibers. Substantial reductions in hygroscopicity and hygroexpansivity without too much loss in physical strength were realized also when, instead of acetone, an emulsion of a relatively small quantity of benzene in water was used for beating and sheet making. On the other hand, the use of organic liquids was unsuccessful with stearoylated fibers even of a very low degree of substitution and in spite of the fact that they swelled in these liquids quite distinctly, which is probably the result of the combined effects of the length of the stearoyl chain and its very pronounced hydrophobic character.

ACETYLATION OF STARCH WITH KETENE. E. A. Talley and L. T. Smith. J. Organic Chem. *10*, 101-5 (Mar. 1945). Starch was acetylated with ketene in acetic acid with sulfuric acid as catalyst. The products were similar to those obtained by acetylating acetic-acid-pretreated starch with acetic anhydride. The question whether ketene combines directly with the alcoholic hydroxyl group or acts through the formation of acetic anhydride is discussed.

VISCOSITY AND MOLECULAR WEIGHT. S. Coppick. Paper Trade J. *120*, 37-40 (Jan. 4, 1945). A comparative study is made of the various methods for determining the solution viscosity for wood pulps. These include cuprammonium, cupriethylenediamine and nitrate viscosities. The molecular magnitude of wood polysaccharide is evaluated from the solution viscosity data determined at various stages during the purification of wood cellulose. Results indicate that nitrate viscosities are much more reliable than either of the basic methods for celluloses containing residual lignin. Noncellulosic encrustants interfere with the solution of the polysaccharide to such an extent as to produce an entirely erroneous picture of the degradation which occurs during the purification of wood cellulose. By suitable calibration the nitrate method for determining the degree of polymerization may be brought into agreement with the TAPPI standard cuprammonium method.

THE TEXTURE OF POLYTHENE. C. W. Bunn and T. C. Alcock. Trans. Faraday Soc. *41*, 317–25 (June 1945). The interpretation of some secondary features of the x-ray diffraction patterns of polythene, namely the breadth of the crystal reflections and the position of the diffuse ("amorphous") band, is considered. X-ray diffraction patterns were observed at temperatures up to the melting point (ca. 120° C.). Changes in the proportions of crystalline and amorphous material occur above 80° C. The *a* edge of the orthorhombic unit cell of the crystalline part increases in length from 7.42 A at 18° C. to 7.65 A at 100° C. The *b* axis remains approximately constant at 4.93 to 4.95 A. Optical evidence indicates a spherulitic structure in polythene. The orientation of the crystals in the spherulites is deduced by reference to the optical properties of drawn fibers. On heating, the temperature at which the material becomes isotropic varies with different specimens; the highest temperature observed in any specimen was 126° C. A suggestion on the mechanism of cold-drawing is offered.

POLYMER-PLASTICIZER INTERACTION. E. M. Frith and R. F. Tuckett. Nature *155*, 164–6 (1945). The thermodynamic background for the interaction between a polymer and a plasticizer is discussed.

Properties

THE INFRARED SPECTRA OF POLYMERS AND RELATED MONOMERS. H. W. Thompson and P. Torkington. Proc. Roy. Soc. Series A *184*, 3-40 (July 23, 1945). A survey was made of the infrared absorption spectra of a number of polymeric substances and their associated monomers. Part I of this paper deals with the hydrocarbon-type polymers such as polythene, polyisobutylene, buna, hydro-rubber, polystyrene, and compounds related to them. The results reveal the existence of methyl groups in polythene, and also of a small number of carbonyl groups. The type of unsaturated products formed during the cracking of polythene is also indicated. The variation of spectrum with chain length was examined using samples of polythene and isobutylene. The influence of state of aggregation was studied and the use of plane

polarized radiation with oriented films of polythene was explored. Part II of this paper deals with the infrared spectra of some polymers containing chlorine and also those of the related monomers. Vibrational analyses and a study of band contours with vinyl chloride, vinyl bromide, vinylidene chloride, and vinylidene bromide, have made it possible to assign magnitudes to many of the normal vibration frequencies. The vibration frequencies of the series of vinyl halides are correlated. The rotational structure associated with some of the vibration bands are discussed in relation to the molecular structure. Similar measurements and considerations are applied to chloroprene. The spectra of polyvinyl chloride, polyvinylidene chloride, and some halothenes and neoprenes were examined. As a preliminary to the correlation of the absorption frequencies with vibrations of the nuclear skeletons, the spectra of some simple chlorinated paraffins were measured. Sixteen references are included.

DIPOLAR PROPERTIES OF RESINS. P. Savic and C. G. Garton. Rep. Brit. Elect. Allied Ind. Res. Assoc., Ref. L/T 135, 8 pp. (1943). An attempt is made to combine mathematically the conceptions of Frohlich on the mechanism of the dielectric properties of dipolar solids and of Garton on the distribution of relaxation times in dielectrics. Experimental results obtained with a synthetic resin are considered.

DIELECTRIC PROPERTIES OF A THERMOPLASTIC M-CRESOL RESIN IN RELATION TO GARTON'S HYPOTHESIS. E. Rushton. Rep. Brit. Elect. Allied Ind. Res. Assoc., Ref. L/T 139, 9 pp. (1943). The dielectric properties of a thermoplastic m-cresol resin are considered by Garton's modification of Debye's theory. Fair agreement was observed above 75° C. At lower temperatures where the resin is brittle, the calculated values are greater than the observed values.

Testing

THE RUGOSIMETER. M. Mooney. Ind. Eng. Chem. Anal. Ed. *17*, 514-17 (Aug. 1945). A new instrument is described for measuring the rugosity, or surface roughness, of calendered raw rubber sheet or similar samples. The property actually measured is the resistance to air flow between the rough surface and a plane test surface resting on it. The apparatus consists essentially of the following elements in series: a constant-pressure air valve, a large needle valve with a calibrated scale, a manometer, and an annular test plate which rests upon the surface under test. The needle valve is opened to the point at which the pressure on the manometer is one-half the pressure maintained by the constant-pressure valve. The resistance of the needle valve to the air flow is then equal to, and measures the resistance of, the test plate on the sample. By a theoretical formula this air-flow resistance is converted to "rugosity height," which is the height of the hills above the valleys in an idealized rough surface of sinusoidal profile.

RING AND BALL SOFTENING POINTS OF RESINS. V. E. Grotlisch and H. N. Burstein. Ind. Eng. Chem. Anal. Ed. *17*, 476-80 (Aug. 1945). The determination of softening point is discussed from a theoretical point of view. Any method of obtaining this value, to be practical, must ignore to a great extent the principle of measuring the transition point while no change occurs in the internal temperature of the system. An airbath method of test for softening point operated at constant temperature is presented, together with experimental data to show that the method is based upon an attempt to link practice with theory. A method is presented for computing the correction to be applied for correlating values obtained at different bath temperatures. The corrected softening point values are also in close agreement with A. S. T. M. E 28-42T ring and ball values. Data are presented showing the application of the method over a range of softening points between approximately 70 and 170° C. The apparatus employed is of simple design, consisting mainly of standard equipment used in making A. S. T. M. ring and ball tests. A scale drawing of a special ring holder is shown. A recommended procedure is presented, more rapid than the regular A.S.T.M. E 28-42T method, and applicable to a wider range of softening points and resin types, from rosin to high-melting synthetic resins. Results may be duplicated within 1.0° C.

SIMPLIFIED METHOD FOR DETERMINATION OF SPECIFIC GRAVITY OF WOOD AND PLASTICS. G. Stern and P. S. Dear. ASTM Bul. No. *135*, 35-40 (Aug. 1945). Using a mercury-balance volumeter, a suggested method is given for simplifying the recommended A. S. T. M. methods for determination of the specific gravity of wood and solid plastics. Comparison is made of test data for yellow poplar and cellulose acetate plastic, obtained according to the various methods employed. The following advantages were found: (1) The mercury-balance method gives as accurate data for small 2 by 2 by ½-in. test specimens as the A. S. T. M. standard method for wood requiring 2 by 2 by 6-in. test specimens. (2) Small-size samples cut from undestroyed parts of specimens previously tested for physical and mechanical properties can be used. (3) Rough, unfinished specimens of any shape can be used. (4) Covering of wooden specimens with a wax film before immersion of the specimens in water, as required by the A. S. T. M. method for wood, is unnecessary. (5) Immersion of the specimens in water, as required by the A. S. T. M. method for plastics is eliminated; thus, swelling of specimens cannot occur.

Synthetic rubber

MECHANISMS OF TEARING NATURAL AND SYNTHETIC RUBBERS. J. M. Buist. Trans. Inst. Rubber Ind. *20*, 155–72 (1945). The resistance to tearing of several natural and synthetic rubber compounds was investigated by ASTM Method of Test D624–41T with 6 different depths of notch and at 21, 50, 70 and 100° C.

CHEMICAL CHARACTERISTICS OF BUTADIENE RUBBERS. A. I. Yakubchik, A. A. Vasil'ev and V. M. Zhabina. J. Applied Chem. (U. S. S. R.) *17*, .07-13 (1944); Chem. Abstracts *39*, 1564-5 (Apr. 10, 1945). Butadiene rubbers were treated with ozone and hydrolyzed. The formic acid and the formaldehyde in the reaction products were determined. The amounts of vinyl-type side chains varied from 27 to 49 percent depending on the method of polymerization used to make the rubber.

RUBBER AND MUSTARD GAS. T. R. Dawson and R. W. Parris. J. Rubber Research *14*, 85-9 (1945). The manufacture of gas-protective materials from rubbers and plastics and their decontamination are discussed. The present trend is toward the use of polyisobutylene and isobutylene-butadiene copolymers. Seventy-three references.

MOLECULAR REQUIREMENTS FOR SYNTHETIC RUBBERS. W. O. Baker. Bell Lab. Record *23*, 97–100 (1945). Molecular requirements for obtaining materials with rubberlike properties are discussed. A molecular picture for explaining the structure of rubberlike materials is presented.

STATIC AND DYNAMIC TESTING OF NATURAL AND SYNTHETIC RUBBERS. Product Engineering *16*, 541-3 (Aug. 1945). The static compressive, vertical shear and side shear characteristics of natural and synthetic rubber are compared. Dynamic tests to determine the damping characteristics were also investigated.

THE COLD COMPRESSION SETS OF NATURAL AND SYNTHETIC VULCANIZATES. R. E. Morris, J. W. Hollister and P. A. Mallard. India Rubber World *112*, 455–8 (July 1945). The cold compression set of several natural and synthetic rubbers was investigated. Two types of cold compression set were found. One type is reversible under isothermal conditions; the amount of retained deformation depends on the time interval between release and measurement of the specimen. The other type is not reversible under isothermal conditions; a proportion of the deformation is retained indefinitely after release.

U. S. Plastics Patents

Copies of these patents are available from the U.S. Patent Office, Washington, D. C., at 10 cents each.

MOLDING. K. J. Kopplin (to F. Burkart Manufacturing Co.). U.S. 2,378,642, June 19. Hollow articles are prepared by laying a criss-cross unwoven mat of long fibers in a forming die, applying a plastic binder and pressing.

RESIN. G. T. Vaala (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,378,667, June 19. A composition comprising a fiber-forming linear polyamide and a compatible phenol-formaldehyde resin formed from a monohydric phenol containing 1-2 substitutable ortho or para positions.

STABILIZER. G. H. Taft (to B. F. Goodrich Co.). U.S. 2,378,739, June 19. The dielectric strength of plasticized polyvinyl chloride is increased by adding the dried product of a water dispersion of lead silicate and a water-soluble lead or barium compound.

BOBBY PIN. S. Berman and V. J. Macaluso. U.S. 2,378,747, June 19. A plastic bobby pin.

VINYL COMPOUNDS. G. F. D'Alelio (to General Electric Co.). U.S. 2,378,753, June 19. A composition comprising the polymerization product of a vinyl halide and a polycarboxylic acid polyester of a nuclearly halogenated aryl ethyl alcohol.

TERPENE RESINS. A. L. Rummelsburg (to Hercules Powder Co.). U.S. 2,378,794, June 19. The copolymerization product of a preformed phenol-aldehyde resin and a monomer or polymer of an acyclic terpene.

JOINING METHOD. P. A. Sidell and E. J. Wellman (to Outboard Marine and Manufacturing Co.). U.S. 2,378,801, June 19. Normally unyielding thermoplastic members having finished outer surfaces provided with mating flanges and spaced metallic reinforcing means embedded in the plastic, the abutting portions of the flanges being fused in the spaces between the metallic members.

DRYING OIL. T. F. Bradley (to American Cyanamid Co.). U. S. 2,378,827, June 19. Drying oils are prepared by esterifying a polyallyl alcohol having at least 5 primary hydroxyl groups with castor, soya bean or linseed oil.

RESINS. L. Coes, Jr. (to Norton Co.). U.S. 2,378-831-2-3-4, June 19. A primary aromatic amine-formaldehyde resin alkylated and cross-linked by a chloroacetate of glycerol dichlorohydrin, a mono- di- or tri-ethylene glycol di-monochloroacetate, tri-methylene glycol di-monochloroacetate, di-2- chloroethyl phthalate, di-2-chloroethyl maleate, di-2- chloroethyl succinate, glycerol tri-monochloroacetate, or tri-methylol propane tri-monochloroacetate.

VARNISH RESIN. H. F. Weide (to Monsanto Chemical Co.). U.S. 2,378,886, June 19. A water-resistant alkyd resin is formed by heating an unsaturated fatty acid oil with glycerine and then heating in the presence of naphthalene with phthalic anhydride.

CELLULOSE DERIVATIVES. W. J. Burke (to E. I. du Pont de Nemours & Co, Inc.). U.S. 2,378,898, June 26. An organic-solvent-soluble cellulose acetate having cellulosic hydroxyl replaced by mercapto-methyl-ether groups.

TEXTILE BOBBIN. H. L. Amrhein and E. E. Fuller (to American Paper Tube Co.). U.S. 2,378,901, June 26. A textile bobbin comprising a tubular fiber barrel and a plastic head molded around the end of the barrel.

POLYAMIDES. M. M. Brubaker (to E. I. du Pont de Nemours & Co., Inc.). U.S.2,378,977, June 26. Synthetic linear polyamides containing mostly secondary amido groups and comprising the reaction product of monoaminomonocarboxylic acids and mixtures of diamines with dicarboxylic acids are polymerized with the reaction product of similar ingredients but having a lower intrinsic viscosity.

CELLULOSE ACETATE. F. E. Piech (to Hercules Powder Co.). U.S. 2,379,036, June 26. A plastic composition comprising cellulose acetate plasticized with a *p*-tertiary alkyl phenoxy ethanol or an acetate ester thereof and also a solvent plasticizer.

TERPENE DERIVATIVES. A. L. Rummelsburg (to Hercules Powder Co.). U.S. 2,379,039, June 26. The reaction product obtained by heating, in the presence of an acid catalyst, a primary or secondary amine with a condensate of an acyclic terpene and crotonaldehyde.

ROOFING. F. B. Wallace. U.S. 2,379,051, June 26. A roofing structure comprising waterproof sheets laid in lapped relation, overlaid with a self-hardening plastic material.

MOLDED PRODUCT. K. L. Landon (to Westinghouse Electric Corp.). U.S. 2,379,163, June 26. A method for molding an object composed of a fibrous material and a heat-curable resinous binder.

CASTING METHOD. W. R. Dial and C. Gould (to Pittsburgh Plate Glass Co.). U.S. 2,379,218, June 26. A sheet of clear resinous polymer of an ester having two terminal alkenyl radicals each containing an olefinic bond is formed by placing the partially reacted liquid and a polymerization catalyst between two glass plates separated by an elastic edge spacer, heating until polymerized to a soft gel, subjecting the mold to a slight pressure normal to the glass sheets, further heating and gradually increasing pressure until polymerization is complete.

PLASTICIZATION. J. D. Jenkin. (to Pittsburgh Plate Glass Co.). U.S, 2,379,236, June 26. A plastic is plasticized by adding a non-solvent to a solution of the plastic to the point of incipiens gelatin of the solution, chilling to effect gelation, simultaneously agitating in order to separate the liquid content by syneresist and precipitating the plastic in suspended finely divided form and finally adding the non-solvent and a plasticizer which is soluble in the non-solvent.

PIGMENTATION. J. D. Jenkins (to Pittsburgh Plate Glass Co.). U.S. 2,379,237, June 26. Fine pigmented powders of organic plastics are prepared by suspending a pigment in a solution of organic plastic, adding a non-solvent until gelation is reached, agitating, cooling until liquid separates by syneresis, forming a suspension of the particles containing embedded pigment particles and finally separating.

COATINGS. I. E. Muskat (to Pittsburgh Plate Glass Co.). U.S. 2,379,246, June 26. An interior coating for metallic containers comprising an alkali insoluble cellulose ether plasticized with an ester containing two unsaturated groups.

SHAPING METHOD. I. E. Muskat (to Pittsburgh Plate Glass Co.). U.S. 2,379,247, June 26. A shaped sheet of a hard polymer of a diester having two unsaturated groups is prepared by cast

polymerizing the sheet, heating between 70° and 150° C, bending without exceeding the elastic limit and finally cooling.

SHAPING METHOD. I. E. Muskat (to Pittsburgh Plate Glass Co.). U.S. 2,379,248, June 26. Curved sheets of a polymerized ester containing two unsaturated groups are formed by heating the monomer in the presence of an organic peroxy catalyst until gelation has begun, curving the sheet in a suitable mold and finally heating to destroy the catalyst and further polymerize the sheet.

FIBERS. R. Wallach (to American Viscose Corp.). U.S. 2,379,264, June 26. Potentially adhesive textile fibers are prepared by carding cellulose fibers with other textile fibers which are inert to etherification, etherifying the fiber mixture, until the etherified cellulose fibers are soluble in alkali, but not in water, washing the mixture, and finally drying and carding the mixture.

COPOLYMERS. A. H. Gleason (to Standard Oil Development Co.). U.S. 2,379,292, June 26. A polymerization process which comprises mixing a vinyl halide with an isomonoolefin, emulsifying the mixture in an aqueous medium together with a peroxide catalyst, adjusting the pH to 8.5, and heating below 100° C to effect substantial polymerization.

CELLULOSE ESTERS. C. J. Malm and L. D. Bearden (to Eastman Kodak Co.). U.S. 2,379,309, June 26. A dicarboxylic acid ester of cellulose is prepared by reacting a cellulose acetate having free hydroxyl groups with the anhydride of the acid, adding trisodium phosphate to neutralize the free carboxyl groups, and separating the ester by precipitation.

CELLULOSE ESTERS. C. J. Malm and L. W. Blanchard, Jr. (to Eastman Kodak Co.). U.S. 2,379,310, June 26. A high viscosity cellulose ester containing at least 30 percent propionyl or butyryl groups is prepared by esterifying cellulose at 125° to 160° F with a mixture of the acid anhydride and zinc chloride.

RESIN. R. L. May (to Sinclair Refining Co.). U.S. 2,379,312, June 26. The reaction product of an alkylated phenol with a condensate of turpentine and phosphorous pentasulfide.

RESIN SALT. R. L. May (to Sinclair Refining Co.). U.S. 2,379,313, June 26. The reaction product of zinc oxide and the condensation product of phosphorous pentachloride and turpentine reacted with an alkylated phenol.

RESIN. F. J. W. Popham (to British Rubber Producers' Research Association). U.S. 2,379,375, June 26. A resin is prepared by intimately mixing oxidized rubber with maleic anhydride, adding oxalic acid as a catalyst and a phenol, heating to 60° C, and finally reacting with formaldehyde.

POLYVINYL CHLORIDE. R. G. R. Bacon and W. J. R. Evans (to Imperial Chemical Industries, Ltd.). U.S. 2,379,409, July 3. A chlorinated resin is prepared from an aqueous dispersion of polyvinyl chloride by passing chlorine gas through the dispersion in the presence of actinic radiation until the desired degree of chlorination is reached.

JOINING METHOD. R. N. Steffens. U.S. 2,379,500, July 3. The end edges of two portions of thermoplastic sheet material are joined by clamping the two portions with the end edges protruding toward each other, moving the clamped portions toward each other against opposite sides of a heated member to melt the edges and then moving the edges into contact to cause fusion of the two portions.

CERAMIC GLAZE. A. J. Deyrup (to E. I. du Pont de Nemours & Co., Inc.). U.S. 2,379,507, July 3. A vitrifiable glaze suspended in an ethyl cellulose solution in a terpene solvent.

POLYAMIDES. W. W. Watkins (to E.I. du Pont de Nemours & Co., Inc.).U.S. 2,379,557, July 3. An opaque synthetic linear polyamide is transparentized by subjecting the structure to treatment with a non-aqueous liquid which is incapable of completely dissolving the polyamide at a temperature above 75° C.

COATINGS. R. C. Swain and P. Adams (to American Cyanamid Co.). U.S. 2,379,604–5, July 3. A coating composition containing benzyl cellulose and a melamine-formaldehyde resin which has been reacted with an alcohol having from 4 to 8 carbon atoms.

COATINGS. R. C. Swain and P. Adams (to American Cyanamid Co.). U.S. 2,379,606–7–8–9–10–11–12, July 3. Coating compositions containing a solid hydrocarbon polymer of the cycloparaffin type obtained by hydrogenating a coumarone, indene, or a mixed coumarone-indene polymer, and a melamine-formaldehyde resin which has been reacted with an aliphatic or aromatic alcohol.

RESIN. G. F. D'Alelio (to General Electric Co.). U.S. 2,379,691, July 3. The reaction product of a chlorinated acetamide with the product of partial reaction of an aldehyde and a diazine derivative.

TEXTILE. O. W. Boies and H. O. Taylor (to Hartford Rayon Corp.). U.S. 2,379,783, July 3. A spinning solution for hollow textile material comprising a solution of an alkali metal hydroxide and a carbonate admixed with a cellulose ester or a cuprammonium solution of cellulose.

EMBEDDING MEDIUM. R. E. Eenigenburg (to Elmo F. Brennom). U.S. 2,379,793, July 3. An improvement in the method of embedding a solid object in a molded object comprising a transparent synthetic resin

LIGNIN ETHERS. R M Dorland and R. M. Boehm (to Masonite Corp.). U.S. 2,379,889, July 10. An etherified ligneous composition prepared by reacting lignin with an etherifying compound at an elevated temperature in the presence of an alkali and water to form a precipitated product.

LIGNIN ESTERS. R. M. Dorland and R. M. Boehm (to Masonite Corp.). U.S. 2,379,890, July 10. Lignin esters are prepared by mixing lignin with water and an alkali to obtain an aqueous alkali lignate solution, adding an esterifying compound and heating until the desired degree of esterification is obtained.

CARBOXYCELLULOSE ESTERS. H. F. Mark and S. Siggia (to E. I. du Pont de Nemours & Co., Inc.).U.S.2,379,917, July 10. An ester of carboxycellulose.

LACQUER. J. G. Little (to Hercules Powder Co.). U.S. 2,379,974, July 10. A coating comprising an ester of a hydrogenated rosin acid and a polyalkylene glycol having at least three alkylene groups connected by ether linkages and a compatible cellulose derivative.

KETONE RESINS. S. S. Ballard and V. E. Haury (to Shell Development Co.). U.S. 2,380,142, July 10. The color qualities of a resinous condensate of an aldehyde and a ketone are improved by hydrogenation.

COATING. N. K. Chaney (to United Gas Improvement Co.). U.S. 2,380,149, July 10. A metal body is coated with a composition comprising the reaction product of a sulfur containing vulcanization agent and a benzene-soluble resinous polymer of cyclopentadiene or a mixture of cyclopentadiene and methyl cyclopentadiene.

CELLULOSE DERIVATIVES. H. Dreyfus (to Celanese Corp. of America). U.S. 2,380,157, July 10. Cellulosic materials are modified by reaction with an organic compound containing two amine nitrile groups.

MODIFIED PHENOLIC RESIN. R. F. Schlaanstine (to Hercules Powder Co.). U.S. 2,380,192, July 10. A pale, color-stable, drying-oil varnish consisting of a heat-bodied mixture of linseed oil, the reaction product of rosin acid crystals, maleic anhydride, and the resinous condensate of *p*-tertiary amyl phenol and formalin, and pentaerythritol.

ADHESIVES. A. M. Howald (to Libbey-Owens-Ford Glass Co.). U.S. 2,380,239, July 10. A dry heat-setting adhesive which remains stable for an extended period is prepared by applying an

aqueous solution of a urea-formaldehyde condensate containing no free formaldehyde to a surface together with an ammonium salt of a strong acid and a quantity of a polyhydric phenol sufficient to delay the reaction of the ammonium salt with formaldehyde liberated from the condensate, and drying.

CONDUCTIVE PLASTIC. B. H. Maddock (to Carbide and Carbon Chemicals Corp.). U.S. 2,379,976, July 10. A tough, resilient, elastic composition having a D.C. resistivity at 25° C of less than 500 ohm-cm. and capable of grounding an electrostatic charge comprising a highly polymerized vinyl chloride resin containing a plasticizer and finely divided carbon black.

COPOLYMERS. H. W. Arnold and G. L. Dorough (to E. I. du Pont de Nemours & Co., Inc.).U.S. 2,380,009, July 10. A copolymer of asymmetrical dichloroethylene with a polymerizable ketone which has a single aliphatic unsaturated group and in which the carbonyl group is attached to a carbon atom attached by a double bond to a methylene group, the other valence of the carbonyl group being satisfied by a monovalent hydrocarbon radical.

PHOTOGRAPHIC ELEMENT. G. L. Dorough and D. M. McQueen (to E. I. du Pont de Nemours & Co.). U.S. 2,380,-032, July 10. A photographic element bearing a water-permeable colloid layer containing a light-sensitive material and a polyvinyl acetal capable of reacting with a diazo compound to form an azo dye.

PHOTOGRAPHIC ELEMENT. G. L. Dorough and D. M. McQueen (to E. I. du Pont de Nemours & Co., Inc.). U.S. 2,380,033, July 10. A silver halide emulsion containing as a color former fast to diffusion an amide of a color former and the acetal obtained by the condensation of polyvinyl alcohol with an aromatic aminoaldehyde.

MOLDING METHOD. P. S. Hauton (to Scripto Manufacturing Co.). U.S. 2,380,042, July 10. An apparatus for injection molding pencil barrels.

SHIELD. J. Karp. U.S. 2,380,050, July 10. An attachable cap for a shoe comprising a shield constructed to enclose the toe and the undersurface of the sole and having a thermosetting film adapted to cement it to the sole.

SUPPORT. W. Gebauer (to Premier Glass Works, Inc.). U.S. 2,380,104, July 10. A support for a pendant ornament.

MODIFIED ROSIN. L. Auer (to Ridbo Laboratories, Inc.). U.S. 2,380,141, July 10. A modified and softened rosin product is prepared by dispersing tetrachlororesorcinol in the rosin and heating out of contact with air to 200° to 350° C until acid value and melting point lower.

EYEGLASS FRAMES. W. A. Whipple (to Chicago Eye Shield Co.). U.S. 2,380,281, July 10. A plastic frame for eyeglasses.

OIL-SOLUBLE RESIN. A Haroldson. (to Continental-Diamond Fibre Co.) U.S. 2,380,307, July 10. An oil-soluble phenol-formaldehyde resin is prepared by combining a heat-convertible, oil-incompatible phenol-formaldehyde resin and a reaction product obtained by heating together an unsaturated dicarboxylic acid, an alkyl abietate and heat-treated soya bean oil.

CASHEW NUTSHELL LIQUID. R. E. Kremers (to General Foods Corp.). U.S. 2,380,319, July 10. Cashew nut shell liquid having 40 to 70 percent anacardic acid content is converted into a hardened plastic by reacting with an alkaline earth oxide or hydroxide in excess of the amount needed for neutralization of the acid, forming and hardening.

INTERPOLYMERS. M. A. Youker (to E. I. du Pont de Nemours & Co., Inc.). U.S. 2,380,356, July 10. Vinylidene chloride, bromide, or chlorobromide is copolymerized with a diene such as 1,3-butadiene, isoprene, or 2,3-dimethyl-1,3-butadiene while in aqueous dispersion in the presence of an alkali metal hydroxide.

LIGHT POLARIZER. E. H. Land and R. P. Blake (to Polaroid Corp.). U.S. 2,380,363, July 10. A light polarizer is prepared by subjecting a linear high polymeric substance to surface orientation by mechanical means.

COATING. H. G. Berger, G. S. Crandall, and J. F. Socolofsky (to Socony-Vacuum Oil Co., Inc.). U.S. 2,380,394, July 31. A liquid coating composition prepared by polymerizing a drying oil containing a Friedel-Crafts-type catalyst, arresting polymerization by adding an inactivator such as quinoline or isoquinoline, and adding resin, thinner, and drier.

LIGNIN. R. Katzen (to Northwood Chemical Co.). U.S. 2,380,448, July 31. Pure lignins are isolated from hydrolyzed lignocellulose by extracting with an alcohol, mixing with an excess of water and drying.

COATINGS. C. E. Maier, S. L. Flugge, and E. C. Pfeffer (to Continental Can Co., Inc.). U.S. 2,380,456, July 31. A coating containing a drying oil having dissolved therein an oil-soluble varnish resin and a vinyl resin.

PLASTIC. O. M. Reiff and J. D. Zech (to Socony-Vacuum Oil Co., Inc.). U.S. 2,380,466, July 31. A plastic composition prepared by heating chlorinated petroleum wax with an aromatic compound such as phenol, a naphthol, or diphenyl ether in the presence of a Friedel-Crafts catalyst, and finally heating with an aqueous alkaline sulfide solution.

ARTIFICIAL TOOTH. J. A. Saffir (to Dentists' Supply Co.). U.S. 2,380,468, July 31. An artificial tooth composed of three joined sections of synthetic resins of diversified properties.

CATALYSTS. W. D. Stewart (to B. F. Goodrich Co.). U.S. 2,380,473–4–5, July 31. Catalysts for the polymerization of vinyl-type polymers comprising a water-soluble heavy metal salt combined with a derivative of a phosphorous oxyacid, an aliphatic keto substituted carboxylic acid, an aliphatic organic compound containing one or two divalent sulphur atoms connected by at least one valence to an aliphatic radical containing at least one hydrophilic group, a sugar, or a naturally occurring compound containing a substituted cyclopentenophenanthrene ring.

COATING APPARATUS. W. R. Brend (to Lock Joint Pipe Co.). U.S. 2,380,499, July 31. An apparatus for applying coatings comprising organic plastic materials.

PLASTIC OBJECT. J. P. Gits (to J. P. Gits and J. A. Gits). U.S. 2,380,515, July 31. An article comprising plastic material and cardboard in combination.

FEED MECHANISM. F. W. McIntyre (to Reed-Prentice Corp.). U.S. 2,380,536, July 31. A feed mechanism which is intended for use with plastic molding machines.

PLASTICIZED PHENOLIC RESINS. H. Kline (to Bakelite Corp.). U.S. 2,380,-599, July 31. Varnish compositions of heat-hardenable character comprising in solution a resinous ammonia-catalyzed reaction product of formaldehyde and a cresol, a xylenol, mixtures of cresols and phenol or mixtures of xylenols and phenol and, as plasticizer, methyl abietate.

CHLORINATED SYNTHETIC RUBBER. G. F. D'Alelio (to General Electric Co.). U.S. 2,380,726, July 31. A chlorinated copolymerizate of 1,3-butadiene and acrylonitrile.

POLYVINYL ACETAL RESINS. J. Dahle (to Monsanto Chemical Co.). U.S. 2,380,824, July 31. Polyvinyl acetal in the presence of an acid is stabilized by subjecting a solution of the resin to the action of a neutralizing agent, forming an aqueous suspension of the resin, and subjecting this to the combined action of a saturated lower aliphatic monohydric alcohol and an ethanolamine.

DEXTRAN DERIVATIVE. G. L. Stahly and W. W. Carlson (to Chemical Developments Corp.). U.S. 2,380,879, July 31. A soluble benzyl ether of dextran is prepared by heating dextran, benzyl chloride, and sodium hydroxide at 140° to 180° C for 3 to 6 hours, decanting, adding benzyl chloride, sodium hydroxide and water, refluxing for 6 hours, and finally separating the derivative.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Frontiers in Chemistry, Vol. IV, "Major Instruments and Their Applications to Chemistry"

Edited by R. E. Burk and Oliver Grummitt

Published under the auspices of Western Reserve University by Interscience Publishers, Inc., 215 Fourth Ave., New York 3, N. Y., 1945

Price $3.50 **151 pages**

In order that graduate students and industrial chemists in the Cleveland-Akron area might enjoy the benefits of lectures by experts, Western Reserve University inaugurated a system whereby distinguished scientists in the field of chemistry were invited to present two lectures each in a series of related topics. Finding these such a success, the university had the lectures published in book form, making them available to a much wider audience and allowing those who attended the lectures to assimilate the material more easily. In some cases the lectures are published in a colloquial style as they were given, in others the lecturer has elaborated upon the original, making it a more complete discussion.

The fourth of the books to appear, this one, showing how optical instruments are applied to solve problems of chemical structure and analysis covers the following topics: electron diffraction and the examination of surfaces, the electron microscope and its applications, X-ray diffraction and its applications, chemical spectroscopy, application of absorption spectra to chemical problems and the infrared spectrometer and its application.

Fundamentals of Mechanics

by Morton C. Mott-Smith, Ph.D. and Marjorie Van de Water

Published by the Infantry Journal, 1115 17th St., N. W., Washington 6, D. C., in cooperation with Science Service, Inc., 1944

Price 25 cents **188 pages**

Based on an official outline prepared by the War Department, this book contains basic information on atoms and molecules, inertia, precision instruments, the lever, speed and acceleration, momentum and recoil, hydraulic press, surface tension, combustion and other related subjects. Photographs and simple diagrams clarify the text. Experiments, suggested experiments and test questions are furnished as aids to learning.

★ AN ATTRACTIVE BOOKLET from Bakelite Corp., New York 17, N. Y., gives the story of the company's phenolic resin glues for plywood. Included is general information on curing periodsand pressures required. Line drawings illustrate applications of plywood bonded with phenolic resin glues.

★ "CELANESE SYNTHETICS FOR the Electrical Industry" outlines plastics, textiles and chemicals produced by Celanese Corp. of America, New York 16, N. Y. Summarized on the novel contents pages are the properties and uses of each material. General characteristics, mechanical and electrical properties are given in the pages which follow. The numerous photographs illustrate a wide range of applications in the electrical field which includes a fluorescent lighting diffuser, molded radio housing, transparent fuse puller and current tester, molded knobs and dials and flame resistant cable insulation. Distribution of the book is intended for all users of synthetics in the electrical Industry, designers, manufacturers, molders and fabricators.

★ THE 54-PAGE CATALOG AND handbook of laminated plastics released by Taylor Fibre Co., Norristown, Pa., presents for ready reference essential factual data and engineering information on phenol fiber, vulcanized fibre, phenolastic fiber, insulation, silent gear material, special laminates, moldings and assemblies. One section is devoted to fabricating data for laminated plastics and the servicing of tools and machines used.

★ TWO BULLETINS OF TWO PAGES each have been issued by Tennessee Eastman Corp., Kingsport, Tenn., under the headings "Tenite II Melt Coating" and "Tenite Cementing and Assembling." Discussed in the former is the coating and impregnating of paper and fabrics with cellulose acetate butyrate. The second leaflet describes the procedure to be followed in cementing together pieces of molded cellulose esters.

★ A BULLETIN ON SILICONE RUBber has been received from General Electric Co., Pittsfield, Mass., which gives technical data clarified by graphs and photographs.

★ THE MANY APPLICATIONS OF melamine in the plastics, textile, chemical, paint and allied industries are described in a 24-page illustrated booklet published by American Cyanamid Co., New York 20, N. Y. Mentioned among the more important of these uses are the value of the chemical in plastics of high arc resistance, in wet-strength paper, in water repellents for fabrics, and in the shrinkage control of wool.

★ CATALOG 9-G OF SOUTH BEND Lathe Works, South Bend 22, Ind., illustrates in full color the entire series of 9-in. engine lathes and toolroom lathes, making an attractive presentation. Descriptions of these, together with the 9-in. precision turret lathes complete the booklet. The lathes described are said to be suited for the production of small precision parts, for exacting toolroom work and for general and specialized use in machine, maintenance, repair and laboratory shops for the working of all metals, plastics and other machineable materials.

★ A SET OF 6 CHARTS ON SAFE Practices around Circular Saws has been received from the U. S. Dept. of Labor. The second in a series of industrial safety charts, the set is composed of line drawings illustrating the do's and don'ts of circular saw operation.

★ "COATED ABRASIVES," A handbook and digest of coated abrasive technology, written by E. B. Gallaher, consulting abrasive engineer, has recently been published by the Clover Mfg. Co., Norwalk, Conn. Completely indexed and illustrated, the handbook includes facts necessary to intelligent ordering of coated abrasives. Up-to-date information is given on abrasives in use, the types of backings, coatings and grain sizes. Information is also presented on the particular job for which each type of coated abrasive material is best fitted.

★ A 48-PAGE, FULL COLOR "HANDbook of Metal Sawing," prepared by W. O. Barnes Co., Inc., Detroit 14, Mich., provides an up-to-the-minute treatise on the subject. Particular attention is paid to narrow width and skip tooth band saws for high speed cutting of soft non-ferrous alloys such as aluminum, magnesium, soft brass, bronze and plastics, compositions, fibers and woods.

★ SHEFFIELD CORP., DAYTON, Ohio, has published a book bound in boards entitled "Sheffield Gages" which is a comprehensive handbook of gages and modern precision gaging instruments. The book, which sells for $1.50, is printed on glossy paper and is provided with numerous photographs of the various machines and their attachments. Gages and

their use are discussed thoroughly. Technical data pertaining to gages is presented in a series of tables and a large tipped-in chart.

★ IN A BULLETIN ENTITLED X-Ray Diffraction Apparatus and Applications," Picker X-Ray Corp., New York, N. Y., describes some of the common uses of x-ray diffraction in studying crystalline substances too minute for observation by microscope, along with photographs of such studies. The company's diffraction unit is pictured as well as the x-ray diffraction tube, the Laue camera, the 214.86 mm. powder camera, the 71.62 mm. camera and also the back reflection camera.

★ IN "WHEELCO ELECTRONIC Controls," a 12-page catalog, Wheelco Instruments Co., Chicago, Ill. provides a convenient condensed listing of its principal equipment. The features and control principle of such instruments as the Wheelco temperature control, indicating pyrometer controllers, input controllers and portable potentiometers are presented herein.

★ INDUSTRIAL DRYING, ITS PRINciples and processing, is treated in Bulletin No. 131, issued by J. O. Ross Engineering Corp., New York 17, N. Y. Starting with definitions and classification of dryers the booklet employs diagrams to illustrate methods of drying. Dryers for plastics, pulp and paper, textiles, rubber and latex, drugs and chemicals, ceramics and pottery are described in some detail.

★ TWO BULLETINS — AQB 500.1 and AQB 400.1 — have been received from Fairbanks, Morse and Co., Pomona, Calif. The former deals with the Fairbanks-Morse Fig. 6310 Niagara propeller pumps and the latter with Fig. 6020 oil lubricated turbine pumps with enclosed impellers. Features of the machines are shown by diagrammatic illustrations which accompany the text.

★ A BULLETIN ISSUED BY UNION Iron Works, Erie, Pa., gives data on a recently developed line of "packaged" resin plants ranging in size from the smallest experimental unit to large tonnage production units. These plants are equipped to process such resins as phenolics, ureas, alkyds and in general those resins made by pressure temperature reactions.

★ CROTONIC ACID, ITS MOLECUlar structure and isomerism, physical constants and properties, chemistry and typical reactions, possible uses and patent literature are discussed in a technical bulletin prepared by Shawinigan Chemicals Ltd., Montreal 1, P. Q., Canada.

★ TWO BOOKLETS HAVE BEEN ISsued by Fischer & Porter Co., Hatboro, Pa., on the subject of the Rotameter. "A New Era in Flow Rate Measurement," in its third revised edition, shows through text, photographs and clever cartoon-diagrams, how the Rotameter works. "The Theory of the Rotameter," a technical booklet with a plentiful dispersal of charts, graphs, tables and equations, gives engineering and technical data on flow rate meters in general and the Rotameter in particular.

★ PLASTICS PROCESSING MAchinery in both laboratory and production sizes is described and illustrated in the 8-page Equipment News released by Farrel-Birmingham Co., Inc., Ansonia, Conn., as Bulletin No. 13-R-422A. Included in the pamphlet are Banbury plastics mixer, Gordon plasticator, plastics mills, plastics calenders and molding presses. Facilities of the process testing laboratory, offered without obligation to those engaged in rubber and plastics manufacture is described, as well.

★ "A TURN FOR THE BETTER IN Positive Pumping Without Pulsation," Book No. 20, prepared by Robbins & Myers, Inc., Springfield, Ohio, gives specifications, photographs and pertinent data on the Moyno line of pumps. These units, which require no pistons, valves or high velocities, are said to be capable of handling practically anything from free-flowing liquids to non-pourable pastes.

★ BULLETIN NO. 645, PUBLISHED by Whitlock Mfg. Co., Elmwood, Hartford 1, Conn., illustrates heat transfer equipment including shell and tube and coil types. Design considerations pertinent to the chemical processing field, including tube bundle and closure construction are shown, as well as individual product data such as fuel oil heaters and power plant equipment.

★ "CASE HISTORIES OF PLASTICS from the D-B Scrap Book" gives in a series of news stories a few of the wartime applications of Dillon-Beck Mfg. Co., Irvington, N. J. Included are such items as a molded razor with a telescopic handle and a rain gage with calibrated inner cylinder, both of which have a definite peacetime value.

★ INDUSTRY AND BUSINESS CAN be supplied with quick references to sources of information on any business subject covered by leading industrial, trade and business publications through a new service recently announced by Industex Co., Chicago, Illinois. Summaries of publication articles printed on 3 x 5-in. index forms, indexed and filed by subject matter will be sent subscribers on a monthly basis for addition to their files.

★ BASIC DESIGN PRINCIPLES INvolved in the Geiger-Counter X-ray Spectrometer are discussed in a technical booklet published by North American Phillips Co., Inc., New York 17, N. Y. X-ray diffraction principles, new instrument requirements, X-ray source, pulse, conditioning, frequency meter circuit, counting meter circuit, meters and controls and applications are subjects included.

★ THE CELLULOSE PRODUCTS Dept., Hercules Powder Co., Wilmington, 99, Delaware, has released a pamphlet on high-solids nitrocellulose lacquers telling what they are, and their advantages. A brief history of the research which led up to the development of this type of lacquer is included.

★ FIBERGLAS IN ITS MANY forms and applications is presented in chart form in a booklet by Owens-Corning Fiberglas Corp., Toledo, Ohio. Intermediary products are illustrated at the far left of the chart which gives major properties and principal uses and, at the far right, an application for each product is suggested.

★ NOW AVAILABLE FOR TOOL AND die makers and machine shop personnel is a revised edition of "Die-Co Accessories Catalog No. 4," published by Die Supply Co., Cleveland 3, Ohio. The listing includes a large variety of die springs, socket screws, saws, jig and fixture parts and toggle clamps.

★ PITTSBURGH PLATE GLASS CO., Pittsburgh 19, Pa., has recently inaugurated a series of four-color booklets detailing the application of color dynamics principles in industry, hospitals and institutions, schools, offices, restaurants, automobile sales departments and the home.

SELF-ADJUSTING TOGGLE CLAMPS, drill bushings, aircraft tools and machinist's tools and gages are described in 4 catalogs just issued by Products Engineering Co., Beverly Hills, Calif.

★ ALLIS-CHALMERS, MILWAUKEE, Wis., has issued a pamphlet dealing with electronic heaters for induction and dielectric heating. The booklet explains the applications of this new unit in modern production methods, showing the differences between induction heating and dielectric heating.

★ A NEW AMERICAN FRACTIONal Horsepower Wedgbelt Drives Catalog released by American Pulley Co., Philadelphia 29, Pa., gives complete price lists and specifications on the line of F. H. P. sheaves and belts. Also included are four pages of condensed and simplified drive tables.

★ "AT HOME IN THE WORLD OF Corrosion" gives the story of Tygon, product of U. S. Stoneware, Akron, Ohio. The series of resins, said to be resistant to most corrosives, is described as to results of tests performed, characteristics of the resins and the wide range of applications possible.

molded *Automatically!*

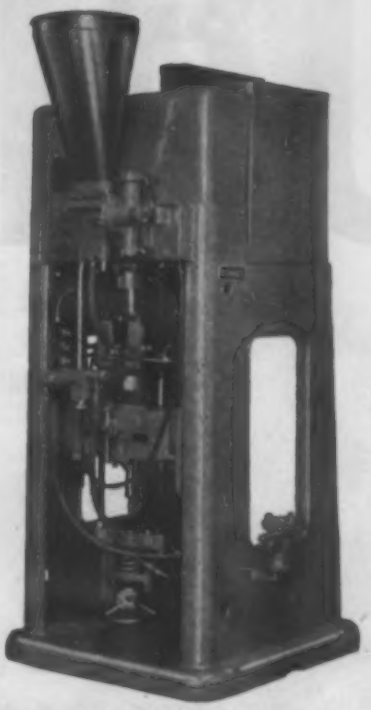
With savings of thousands of dollars per year.....

Caps for a nationally-known brand of pens and pencils used to be molded by conventional methods. The large, multiple-cavity molds needed to hold labor cost per piece within reason produced a year's supply in a few weeks. Result — heavy inventories and large mold investment lying idle.

Now these parts are molded automatically, as needed, on Stokes Presses. The savings in labor costs and inventory total several thousands of dollars per year. *Plus* an "extra" bonus — accuracy is so improved that rejects and time lost in assembly are negligible.

Investigate the demonstrated economies and competitive advantages of Completely Automatic Molding now.

F. J. STOKES MACHINE CO.
6934 Tabor Road Philadelphia 20, Pa.



(Stokes 200-D Completely Automatic Molding Press. 15 tons capacity.)

50th year of Service to Industry

F.J.Stokes MOLDING EQUIPMENT FJS Est. 1895

TINY GIANT WITH A HISTORY

Long before the war, the mén who design your Bell Telephone System were looking for an electron tube with frequency capabilities never before attained. With it, they could transmit wide bands of telephone messages — several hundred of them — simultaneously through coaxial cable—economically, and over long distances.

They developed a tube which set a new standard in broad-band, high-frequency amplification. So minute that its electrode system had to be inspected under a magnifying glass, the tube could amplify either the voices of 480 people talking at the same time, or the patterns of television. Long-distance, broad-band transmission became a commercial reality.

6AK5

Cross-section of Electrode System (five times actual size)

When war came, this tube excelled all others as an amplifier in certain military equipment. It then grew into the 6AK5, one of the great little tubes of the war. Besides producing 6AK5's in large quantities, the Western Electric responded to emergency needs of the Army and Navy by furnishing design specifications and production techniques to other manufacturers, of whom at least five reached quantity production. On every battlefront it helped our ships and planes to bring in radio signals.

Developing electron tubes of revolutionary design has been the steady job of Bell Laboratories scientists ever since they devised the first practical telephone amplifier over thirty years ago. Now tubes like the 6AK5 will help speed the living pictures of television, as well as hundreds of telephone conversations simultaneously over the coaxial and radio highways of the Bell Telephone System.

BELL TELEPHONE LABORATORIES

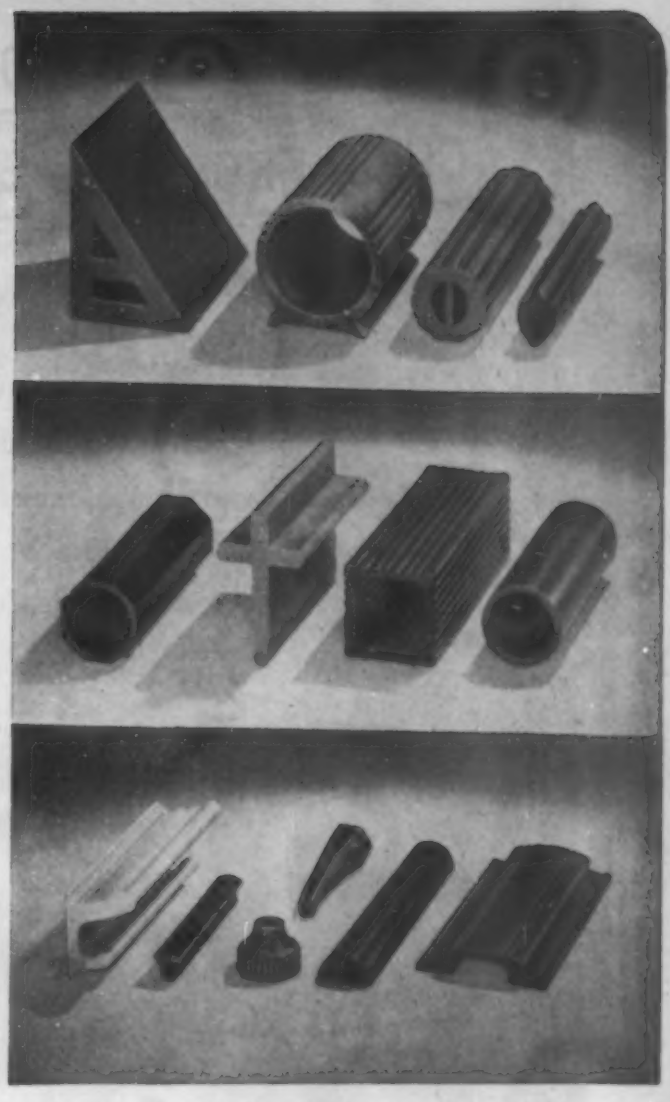
Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service.

MARBLETTE

THE *Versatile* PLASTIC

A CAST PHENOLIC RESIN OF EXCEPTIONAL QUALITIES

- Outstanding among plastics, Marblette has a jewel-like depth and a complete color range which duplicates the appearance of precious stones, tortoise shell and ivory.
- Its almost infinite variety of colors is available in transparent, translucent, opaque, or in mottled effects. Marblette also comes in a waterclear form known as "Crystle" in a wide choice of colors.
- Marblette's machining characteristics, resistance to oil and acids, non-inflammability and exciting beauty make it ideal for countless manufacturing needs.



A few of the many types of Special Marblette castings made to customer's specifications.

SPECIAL CASTINGS

Marblette is supplied in sheets, rods, tubes, and special castings such as cutlery handles, kitchen utensil handles, pipe stems, cigarette holders, clock cases, automotive trimmings, jewelry items, buckles, etc. Special shapes made to customer's specifications can be supplied provided draft is all one way.

MARBLETTE LIQUID PHENOLIC RESINS

Casting Resins for Forming Dies and Tools

Metal Casting Sealing Resins

Bonding Resins

Low Pressure Laminating Resin

Bristle Setting Cement

Laminating and Insulating Varnish

Clear Phenolic Lacquer

MARBLETTE WILL HELP PLAN YOUR WORLD OF TOMORROW

The Marblette staff of engineers offers its services to help with your manufacturing problems. Write to us outlining your needs.

THE MARBLETTE CORPORATION

Manufacturers of Phenolic Resins Since 1929

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TOMORROW'S HEADLINES IN PLASTICS COME FROM ECLIPSE TODAY . . .

If your product lends itself to the practical use of any type of modern plastic, it will pay you to let the ECLIPSE Custom Designing Department study your problem. In all likelihood, a logical solution will result — as it did with this typical redesigning job . . . . .

ECLIPSE Designers changed this conventional-type Voltage Meter Carrying Case.

. . . to a sound functional design, with carefully harmonized eye appeal that demonstrates Eclipse' basic grasp of the principals of good Plastic design.

Send For your copy of our informative Brochure "So You're Going to Use Plastics?"

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5151 N. 32nd St., Milwaukee 9, Wis.

Please send us our copy of your Brochure — "So You're Going to Use Plastics?"

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The ECLIPSE organization, combining dramatic imagination, creative skill, and practical engineering "know-how", can design, mould, mass-produce any product that rightfully belongs in the field of modern Plastics. It will cost you nothing to send us your prints and specifications for our careful study and recommendations.

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COMPRESSION • INJECTION MOULDING IN ALL PLASTIC MATERIALS

Proved in Food Products! C. P. glycerine is a food itself, substantially equivalent in food value to carbohydrate. It has high sweetening power. No wonder it's used by so many manufacturers!

Proved in Cosmetics! C. P. glycerine's non-toxicity, emollient properties, resistance to evaporation, solvent power, and compatibility make it ideal for use in many cosmetics. Use glycerine!

Why Glycerine is a Superior Humectant: PERMANENCE

GLYCERINE as a humectant is permanent. Its permanence is a result of its low vapor pressure, its compatibility with hydrophilic materials, and its lack of tendency to "creep."

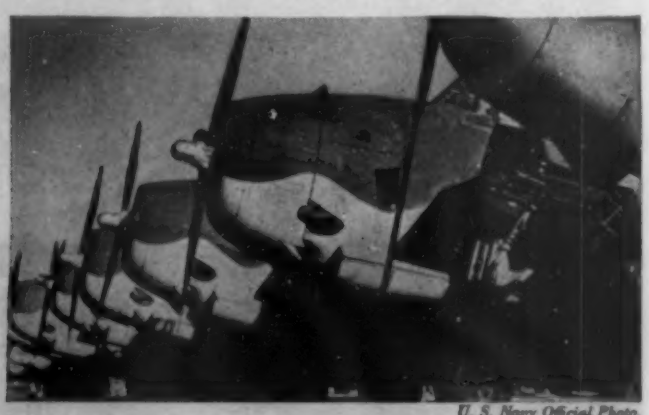
In the absence of a permanent humectant, glues dry out and are no longer adhesive and flexible; paper wrappings become dry and brittle; tobacco gives a less smooth and mellow smoke; cosmetics and dentifrices cake and crack; certain leather products become harsh and rough.

Does the adhesive on your scratch-pad or in a bookbinding become brittle? If so, the chances are that it has not been plasticized with glycerine but with some other material.

Glycerine is not only a superior humectant but a preferred plasticizer, solvent, carrier, preservative, lubricant, and key component in many essential products and materials. Its high viscosity, high solvent power, compatibility, non-toxicity, and other valuable properties can help you make superior products. Use glycerine, the time-tested ingredient, now freely available for the production of civilian goods. Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y., Dept. J-8.

Proved in Medicines! C. P. glycerine, used as a solvent, carrier, and component of ointments, emollient solutions, plasters, and many other pharmaceuticals, is an old standby — proved safe.

Proved in Packaging! Because C. P. glycerine is non-toxic, it is used in the manufacture of transparent wrappings coming in contact with foods or food products. Use glycerine—and be sure!



U. S. Navy Official Photo.

Tough Paints! Long-lasting paints for war equipment and for widespread industrial and home use have been made possible with alkyd resins, of which glycerine is an important raw material.

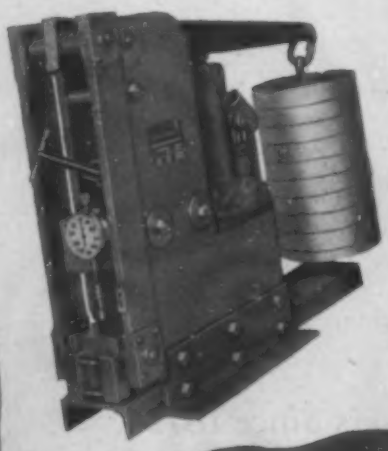
HE Only Oven MADE EXCLUSIVELY FOR THE EFORMATION OR COLD FLOW TEST OF Plastics and Rubber

ASTM D-530, D-621 AND FEDERAL SPECIFICATIONS LP-406-A. METHOD No. 1101

FEATURES

s oven is a "Precision" floor type chanical convection oven with nperature range from 49° to 100° It is equipped with one adjustable ermostat and one Merc-to-Merc hermostat for fixed temperatures permitting quick change of tempera- ture setting. The oven is constructed of sheet metal throughout, with stain- less steel interior. Two fully insulated outer doors open upon 2 inner Pyrex glass doors, permitting observation of deformation on the dial gage without loss in temperature. Two rear opening doors facilitate loading and unloading. All doors open to the full width and height of the test chamber. The finish is of high temperature re- sisting aluminum. The outside dimen- sions are 61" wide x 42" deep x 78" high. Electrical characteristics: 220 or 440 Volts, 60 Cycles, Three phase current, 7200 Watts.

Write for complete information in Bulletin No. 10019-H



THE "PRECISION" DEFORMATION OR COLD FLOW TEST OVEN

Specifically developed to accommodate four "Precision" Deformation or Cold Flow Testers (see illustration on the **left**) this oven incorporates many unusual "Precision" engineering features which permits easy, accurate testing in rigid conformity to A.S.T.M. methods as designated above. The tester in conjunction with this oven measures the flow, or deformation of a ½" cube of plastic, hard rubber or fibre which under- goes a constant, sustained compression of 1000 lbs.—equivalent to 4,000 lbs. per square inch, at the specified temperature. Allows four specimens to be tested simultaneously.

The Deformation or Cold Flow Tester can be used to measure the com- pression and recovery of sheet packings, cardboard, composition, fiber- board, wood, plywood and rigid elastomeric sheets. It can be used wherever the compression and/or recovery is desired using a fixed load of from 100 to 1000 lbs. in increments of 100 lbs.

See Your Laboratory Supply Dealer

PRECISION SCIENTIFIC COMPANY
1736-54 N. Springfield Ave., Chicago 47, U.S.A.
ngineers and Builders of Scientific Research and Production Control Equipment

"MOLEHILLS *out of* MOUNTAINS"

That's what Martha, the Machine and "Metalite" are doing to this job of deburring these phenolic mounting strips for radar equipment.

Those little pieces with a Swiss-cheese appearance are only 14" long and 2" wide, but they held plenty of grief when deburred along the edges by hand; tired fingers and monotonous hours were many.

Now, Martha smiles as she merely guides this vital part past a Metalite Cloth belt—simple, fast, easy.

Coated Abrasives—belts or other ready-to-use forms—can be truly economical by improving speed, volume and finish of output with a gratifying reduction in operator fatigue.

Abrasive engineering service is available free. Just drop a line on your letterhead or, quicker yet, phone our nearest branch.

Coated Abrasives for Discriminating Users Since 1872

BEHR-MANNING
(DIVISION OF NORTON COMPANY)
TROY, N. Y.

BRANCHES: Boston, Buffalo, Chicago, Cleveland, Cincinnati, Grand Rapids, High Point, Indianapolis, Detroit, Los Angeles, New York, San Francisco, Philadelphia, St. Louis, Tacoma.

You're asking Me what I want in a Resin?

I want a resin that we don't have to "adjust" each time we start a run. I want one that won't slow down production and boost costs. I want a resin that gives uniform results. And I never saw a resin like that 'til we threw out stock resins and turned to Interlake.

INTERLAKE has proved for *many* large industrial users that—when a resin is scientifically prepared for only *one* specific application, and its production stabilized, then — and *only* then—is dependably uniform performance achieved.

Interlake *specializes* in the development of Specification Resins—for individual applications—so stabilizing the production of each resin that the performance of every shipment delivered is identical with the first.

IF YOU HAVE A RESIN PROBLEM, draw freely upon the wide experience of Interlake. We will gladly work with you on any resin problem, or discuss with you the possible advantage of using resins in any operation or process. Write Interlake Chemical Corporation, Plastics Division, 1911 Union Commerce Building, Cleveland 14, Ohio

Interlake Production-Stabilized Resins have been developed to precise requirements of coating, impregnating, and bonding . . .

WOOD • PAPER • METAL • GLASS
FIBRE • RUBBER • CELLULOSE

INTERLAKE CHEMICAL
Corporation
PLASTICS DIVISION

Specificity IN RESINS

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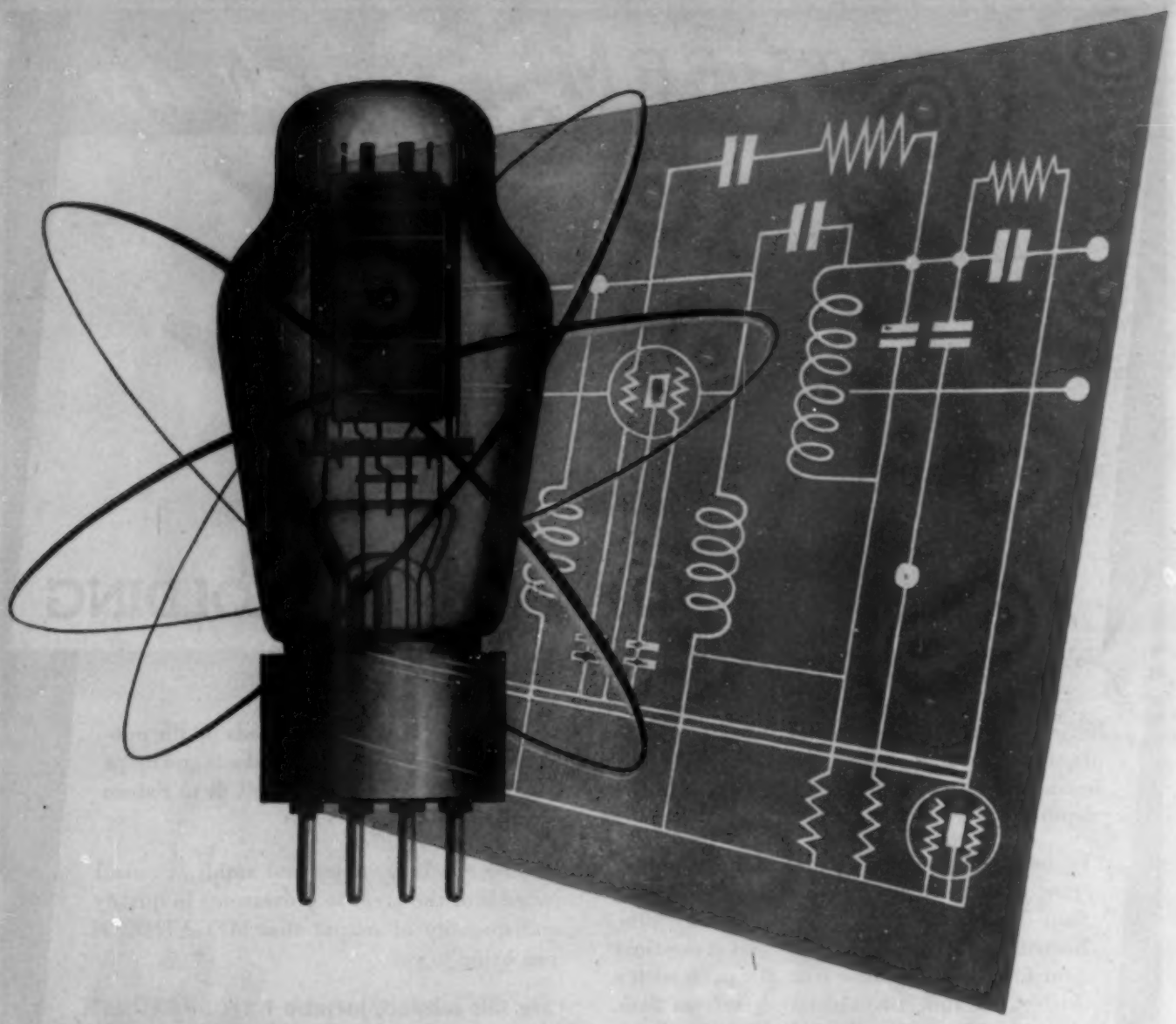
"How does that plastic stuff hold up—pretty well?"

A free ride around the plastics industry is "A Ready Reference to Plastics" our little book. You may have a free copy if you are a business man or a Government employee.

Can you Imagine
Dignified White-Goateed
Molding Sales Managers
Sitting in Their
Modernistic Offices
Worrying about These Kids
And Their Reactions
To Plastics?
Well, They Do,
And About All Other
Plastics Users, Too.
The Plastics Industry.
Is Sweating Out
The Next Decade
Right Now.
So, Please Pardon
Our Mistakes.
Sometimes We Are
Too Quick and Eager,
The Heart Is Sound.



Decide AT THIS POINT to use TAYLOR FIBRE

WHETHER YOUR POST-WAR PRODUCT will be in the field of electronics or aviation, automotive or home appliance, or any field in which light weight, ease of machineability, high insulating qualities or structural strength are important, decide now—in the blueprint stage—to give thorough consideration to the advantages of using Taylor Laminated Plastics. New, war-born developments in Phenol Fibre and Vulcanized Fibre may change your whole conception about the possible applications of Laminated Plastics. Our engineering department is ready to consult with you on this subject, without obligation, either in our plant or yours. Start the ball rolling, by writing us today.

TAYLOR FIBRE COMPANY

LAMINATED PLASTICS: PHENOL FIBRE · VULCANIZED FIBRE · Sheets, Rods, Tubes, and Fabricated Parts

NORRISTOWN, PENNSYLVANIA · OFFICES IN PRINCIPAL CITIES · PACIFIC COAST HEADQUARTERS: 544 S. SAN PEDRO ST., LOS ANGELES

For Plastic Molding Use This Hy-Speed Baldwin Press with Electronic Heating

In one production test, workmen turned out 20% more pieces with an experimental 6-cavity mold than were turned out with a standard 24-cavity compression mold. Mold savings in this instance were estimated at $6000. In addition, the precise extrusion eliminated flash and sprue, and produced a saving of 12½% in plastics material.

Other savings and advantages revealed by the production performance of the equipment are: (1) reduction of initial investment through use of a smaller press; (2) less wear on molds, permitting use of more easily hobbed materials, and extending mold life; (3) considerable reduction in finishing.

These results are convincing evidence of the possibilities of this new process. Baldwin engineers will be glad to work with you, in developing practical applications to your production needs. If you would like a complete story of the new press, ask for Bulletin No. 221. The Baldwin Locomotive Works, Baldwin Southwark Division, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston, Pittsburgh, Detroit.

BLW THE BALDWIN GROUP

BALDWIN

HYDRAULIC PRESSES

EYES *work better*

with the personally-fitted lighting of

DAZOR *Floating* LAMPS

Many of your workers are handicapped by defective vision. You *can't* give them better eyes but you *can* help balance sight inequalities with Dazor *Floating* Lamps: flexible, *localized,* high intensity lighting which provides an *individual fit* for each operator. And easy does it! Fingertip pressure *floats* the Dazor to any desired position, where it *stays put*—without locking or tightening—until moved elsewhere. This is due to a patented enclosed spring force which balances the arm automatically.

Whether for eyes old or young, sound or defective, Dazor *Floating* Lamps make seeing easier on all jobs requiring concentrated and prolonged vision: precision machine work, inspection, fine assembly, and drafting. They help increase output, reduce spoilage, minimize fatigue, promote safety and increase profits.

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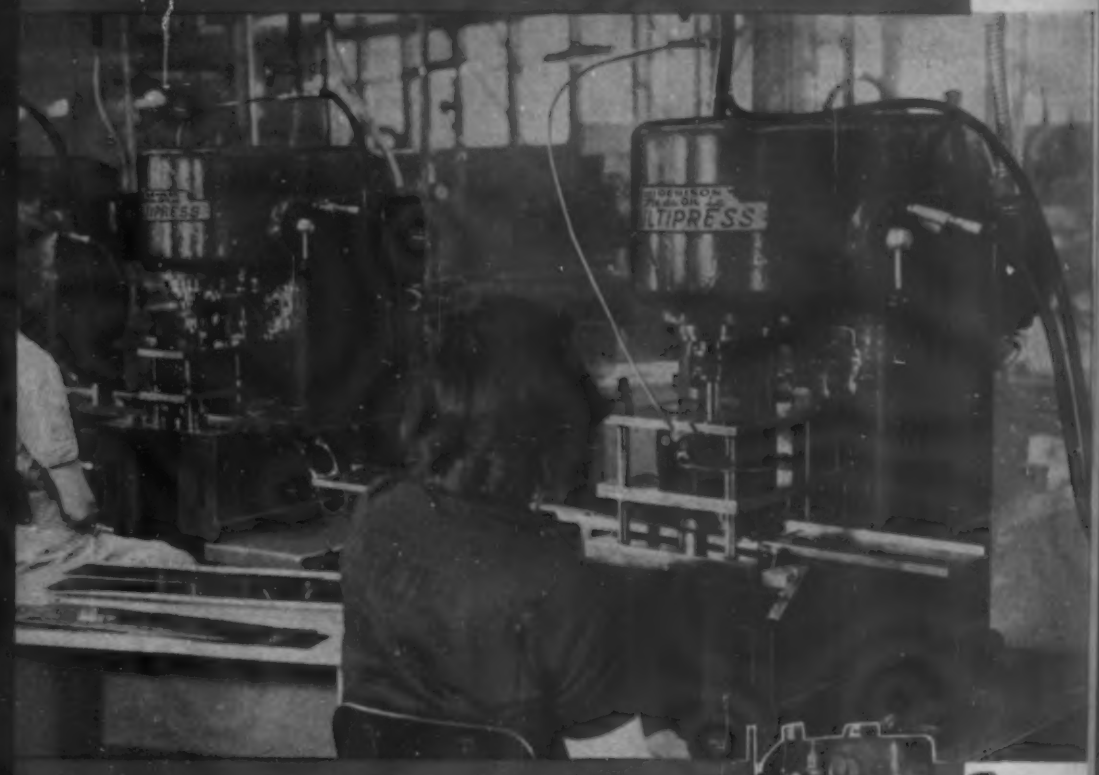
For complete information, experienced application assistance and a practical on-the-job demonstration, phone one of the Dazor-appointed distributors in your locality. Their names, if unknown to you, can be secured by writing to the Dazor Manufacturing Co., 4483 Duncan Ave., St. Louis 10, Mo.

IN CANADA address all inquiries to Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

DAZOR *Floating* LAMPS

FLUORESCENT *and* INCANDESCENT

Deep-drawn containers produced at high speed and less cost with . . . . . MULTIPRESS



Buckeye Stamping Saves 66% on Floor Space . . . 33% on Initial Investment

MULTIPRESS *blanks and draws* seamless metal cans and boxes at the rate of one every second, in The Buckeye Stamping Company plant at Columbus, Ohio — a blanked and formed container with each complete ram stroke! And along with this high-speed production, MULTIPRESS saves *two-thirds* of the floor space previously used . . . features a relief valve that prevents damage to dies in case work jams . . . requires less experience for skillful operation . . . reduces fatigue and increases safety for the operators. *And cost of the complete MULTIPRESS installation was one-third less than equipment formerly required!*

These MULTIPRESS savings are typical. Its performance in scores of plants on dozens of operations proves that MULTIPRESS is Industry's New Tool of amazing advantages.

MULTIPRESS is an extremely compact, bench-size, oil-hydraulic machine tool, built in four, six and eight-ton capacities. Ram pressures are regulative from 300 pounds to capacity . . . ram strokes from 1/32-inch to capacity.

Get full details on MULTIPRESS and its remarkable accessories—including indexing tables . . . straightening fixtures . . . automatic cycling controls . . . *and the revolutionary* VIBRATORY RAM ACTION *all Industry is talking about!* Write today!

The DENISON Engineering Company, 1176 Dublin Road, Columbus 16, Ohio

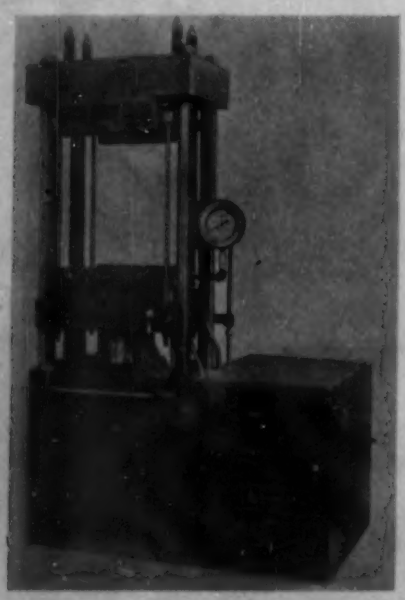
HYDROELECTRICS INDUSTRY'S RIGHT HAND

DENISON EQUIPMENT IS APPLIED HYDROELECTRICS

NEW MACHINERY AND EQUIPMENT

★ GEHNRICH OVEN DIV., W. S. Rockwell Co., New York 7, N. Y., has developed a shelf-loading oven with a self-contained heating system combining the advantages of an internal heating system with air recirculation for quick removal of volatiles which emanate from the work during baking and drying operations. The oven is constructed throughout of insulated steel paneling with thickness of insulation depending upon the temperature of the process. A line-type gas burner connected to a motor-mix proportioning unit, fires into the combustion chamber at the left of the oven. By means of a recirculating fan mounted on the roof, the heated air is forced through a distributor duct at the right-hand side of the oven so that it moves across the width of the oven, above and below each shelf or tray, and on through slots in the combustion chamber for recirculation. Also mounted on the roof is a motor-driven exhaust fan which draws off the volatiles.

★ THE HYDROLECTRIC PRESS—a 50-ton machine for the molding of plastic products—may be operated at any required pressure from 200 to 1000 p.s.i. with corresponding tonnage variations of 10 to 50 tons through adjustment of control hand wheel. R. D. Wood Company, Philadelphia 5, Pa., manufactures the machine whose operations are controlled by



a lever-operated four-way piston-type valve which is arranged to exhaust automatically by a timer-controlled solenoid. This unit is furnished complete with indicating gages and is ready for immediate use when connections with electrical supply lines are made.

★ VERY HIGHLY DEFINED COLOR matching is possible with the Analyte Color Comparator developed by Analyte

Instruments, Inc., New York, N. Y. The new comparator, which is said to achieve the nearest possible reproduction of true north light, gives unusually accurate color separation, reducing color matching errors to a minimum. For contrast the unit is also equipped with incandescent light. Lightweight and small enough to be set upon a table, the machine can be operated by either foot pedal or hand manipulation. The folding shelf for use in color matching small articles is adjustable to two heights. Piece goods may be drawn across the face of the unit, as an additional feature designed for convenience.

★ THE FEDERAL TELEPHONE and Radio Corp., Newark, N. J., has developed a compact power tube designated F-5303, the first in a series especially designed for industrial use in high-frequency heating equipment. The tube is supplied with 6-in. flexible copper leads permanently secured to the terminals. This feature eliminates glass damage frequently encountered by industrial users in attaching and adjusting terminal clamps on a tube. This tube has sturdy, conservatively spaced filament and grid elements. There is no ceramic insulation, either internal or external.

★ "MULTI-DRILL," A NEW 6-spindle, universally adjustable multiple spindle drilling attachment which can be easily and quickly installed on most types of drill presses, has been put on the market by Commander Manufacturing Co., Chicago 24, Ill. This attachment is said to permit the use of drills without restrictions as to their relative position, within the capacity limits of the attachment, and to make possible the operation of the drills as close together as $^{11}/_{16}$ in. between centers.

★ BOLDUC SPECIALTIES CO., Detroit 4, Mich., manufactures a pierce die insert extractor which reduces to a matter of a few minutes the normally difficult and time-taking operation of removing inserts. One set, Model B32, consists of 16 extractors which will remove any insert with hole size ranging from 0.258 to 0.510. The pulling power is said to be limited only by tensile strength of the threaded portion of the smallest extractor which pulls well over 2500 lb. Standard sets for larger holes will soon be available and special extractors can be made to specifications for liners, ball bearings, bushings, etc.

★ A LEAKPROOF JOINT, CONSISTing of four simple interchangeable parts, is being produced by Flexo Supply Co., St. Louis 8, Mo., in all standard pipe sizes from $^1/_4$ in. up to and including 3 in. with threaded ends. This joint, which can swivel through 360° yet maintain positive control over flow of steam, air, fluids or

suction under high or low pressure is applicable wherever pipe flexibility is a necessity. For working pressures up to 250 lb. and for temperatures not exceeding 500° F. the joints are made of bronze. Cast steel, however, is used for pressures up to 1350 lb. as well as for temperatures which are above 300° F.

★ STANDARD MEASUREMENTS OF the stiffness and resilient qualities of flexible materials up to $^1/_8$-in. thickness can be determined with the Taber V-5 power-driven stiffness gage, product of Taber Instrument Corp., North Tonawanda, N. Y. According to the announcement, the new instrument, without the addition of attachments, measures initial and normal stiffness characteristics for laminated plastic, cardboard, light metallic sheet, wire as well as other similar materials. Weighing only 15 lb., the instrument is portable and can be plugged into any 115-volt, 60-cycle circuit.

NEWS OF THE INDUSTRY

★ A NEW PLANT SITE OF ABOUT 400 acres was purchased by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., at Washington, D. C., near Parkersburg, W. Va. One of the first units to be built at this location, according to a recent announcement, will be greatly expanded facilities for the manufacture of methyl methacrylate resin, polythene and nylon. The last named will be produced in various forms including nylon polymers, bristling filament, sheets, rods, tubes and molding powders.

★ A NEWLY EQUIPPED FABRICATing plant has been opened at Trenton, N. J., by the Panelyte Division, St. Regis Paper Co., New York, N. Y. The new plant adds more than 60,000 sq. ft. of production space to facilities of the division.

★ A RESORCINOL ADHESIVE which sets at room temperature and develops the joint strength, moisture resistance and durability usually associated only with hot press phenolics has been developed by Resinous Products & Chemical Co., Inc., Philadelphia 5, Pa. The new resin, known as Amberlite PR-115, is suited to bonding applications where speed of cure, good adhesion to relatively impervious surfaces, good gap filling qualities and the ultimate in durability are important requirements. Although it was originally developed for gluing wood to wood, the resin is said to show good adhesion to laminates, rubber and transparent plastics.

★ CONTINENTAL CAN CO., INC., New York 17, N. Y., has acquired the stock of Gould Paper Co., Lyons Falls, N. Y., manufacturers of ground wood specialties. The new properties, including plants and natural resources, will permit the expansion of operations for both paper and plastics.

★ AS THE RESULT OF AN AGREEment between Westinghouse Electric Corp., Pittsburgh 30, Pa., and U. S. Plywood Corp., New York 18, N. Y., the latter becomes exclusive distributor for "Decorative Micarta," a laminated plastic sheet made by Westinghouse.

★ A THIRD ROOM TEMPERATURE setting durable resin adhesive has been announced by Pennsylvania Coal Products Co., Petrolia, Pa., to be identified as Penacolite G-1215. The new adhesive is characterized by a 3½ hr. working life at 75° F. yet is said to develop extremely high early strength in wood joints glued at that temperature. It can be mixed with additional walnut shell flour and water to provide rapid curing, durable adhesive.

★ PLANS ANNOUNCED BY GENeral Electric Co., Pittsfield, Mass., include a plant for the manufacture of laminated plastics to be constructed at Coshocton, Ohio, and a proposed plastics plant at Wallingford, Conn. The latter plant will house the present Meriden facilities. Further announcements disclose that Everett L. Stewart has been appointed production supervisor of Plastics Divisions of the company and that Arthur Treece is the new manager of Pittsfield Molded Products of that division.

★ B. F. GOODRICH CHEMICAL CO., Cleveland 15, Ohio, has announced the awarding of a construction contract for its semi-works plant to be erected at Avon Lake, near Cleveland, at a cost of about $600,000. The new plant, which is designed as a versatile small-scale chemical plant that can easily be converted to a variety of processes, will be used to develop manufacturing routines for new synthetic resins and chemicals. Present plans call for the processing of new adaptations of the company's line of Geon polyvinyl chloride resins, as the intermediate operation between the pilot plant of the laboratory and full-scale commercial production.

★ BUILDINGS HAVE BEEN ACquired in Summit, N. J., by Celanese Corp. of America, New York 16, N. Y., for the purpose of concentrating in a single central laboratory the firm's vast technological and research activities in the fields of textiles, plastics and chemicals. When the project is completed, about 500 scientists, chemists and technicians are expected to work in the new unit. A further announcement by the corporation reveals the election of Edward W. Ward as Vice-president of Celanese Plastics Corp.

★ INDUSTRIAL TAPE CORP., NEW Brunswick, N. J., has announced the formation of an Adhesive Cement Division to produce and service a line of rubber-based and resin-based cements. Included among the new products are special cements for use in bonding and combining plastics, rubber, textiles, metals, wood.

★ THREE NEW MANUFACTURING plants for the production of chemical color pigments are planned by Reichhold Chemicals, Inc., Detroit 20, Mich. Sites selected are in Detroit, San Francisco and Tuscaloosa, Ala. These will be in addition to the present plant in Brooklyn.

★ RECENTLY OPENED IN BOSton, Mass., is a Plastics Center to serve as a permanent exhibit of products developed and designed by New England Advertising, Inc., Boston 14, Mass., and Beacon Products Corp. The exhibit, located in the Statler Office Building, will make educational and general plastic information available.

★ ANNOUNCEMENT HAS BEEN made of the retirement of Gaston F. DuBois, vice-president and member of the executive committee of Monsanto Chemical Co., St. Louis 4, Mo. He will continue as a director and act as consultant.

★ HERCULES POWDER CO., WILmington 99, Del., has announced the election of William R. Ellis and Mahlon G. Milliken as vice-presidents of the company. Phillip B. Stull, Mr. Ellis and Mr. Milliken were also elected to the executive committee.

"Careers for Cellulose," an industrial film of Hercules Powder Co., which traces the manufacture of cellulose plastics from the cotton field to the finished plastic article will be translated and shown to 20 Latin American countries by the Office of Coordinator of Inter-American Affairs.

★ THE INCREASING IMPORTANCE of the manufacture of chemical products from petroleum has been a factor in the organization of a chemical products department by Standard Oil Co. of Indiana, Chicago, Ill.

★ ARNOLD BRILHART, LTD., Great Neck, N. Y., has announced plans for the construction of a plant at Huntington, N. Y. The new structure, to be completed about May 1946, will be equipped to handle the same type of work as the old plant: injection, compression and transfer molding, die making, designing and the making of precision instruments.

★ ARCO CO., CLEVELAND, OHIO, has revealed plans for the construction of a two-story research laboratory for the development of improved paints, lacquers, varnishes and industrial coatings. The new laboratory will be located adjacent to the firm's general offices at 7301 Bessemer Ave., Chicago, Ill.

★ DONALD WILLIAMS AND DONald K. Ballman have been appointed general sales manager and assistant general sales manager, respectively, of Dow Chemical Co., Midland, Mich.

Sorry!

★ IN "DECORATIONS ON DISPLAY," (Oct. 1945, p. 121), the correct spelling of the designer's name is: "B. Aristide Cianfarani."

On October 1st the Washington office of MODERN PLASTICS closed. However, R. L. Van Boskirk, Washington editor, will continue to cover all major developments related to the plastics field but will make his headquarters in the New York office.

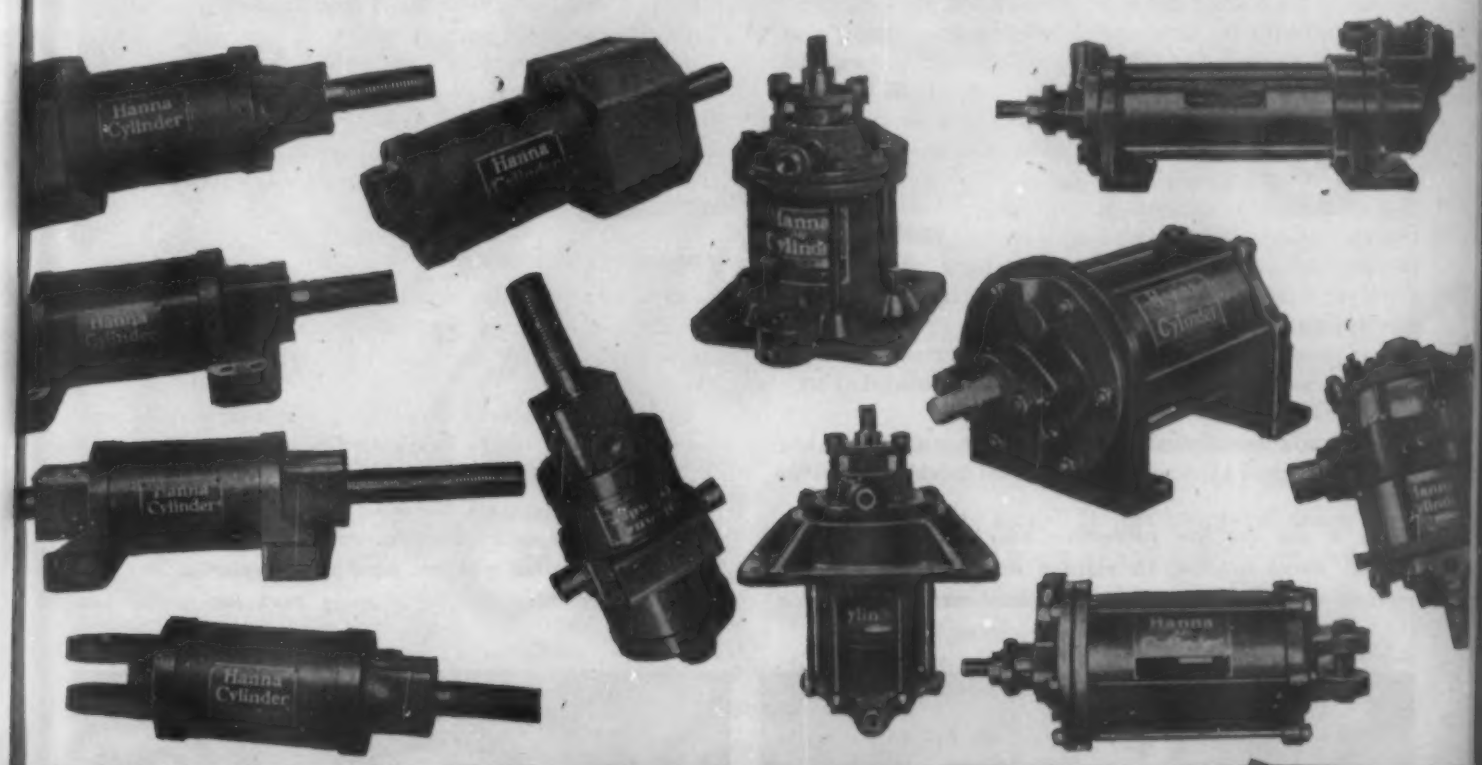
Hanna Cylinders

. . . dependable sources of smooth efficient power

Hanna Cylinders supply efficient, economical power wherever smooth action is needed in pushing, pulling, lifting, pressing, clamping or controlling. They save time and labor through the elimination of manual effort or by replacing complex and inefficient methods. There is a standard model Hanna Cylinder to meet practically every requirement for size, power, length of piston stroke and mounting. The rugged construction and simplified design of Hanna Cylinders insure a maximum service life with a minimum of maintenance. Where can you use Hanna Cylinders?

HIGH PRESSURE
HYDRAULIC . . . FOR WORKING PRESSURE UP TO 1500 P. S. I.

LOW PRESSURE
AIR AND HYDRAULIC . . FOR WORKING PRESSURE UP TO 250 P. S. I.



. . . send for this helpful literature

The new Hanna Hydraulic Cylinder Calculator provides a way for quick, easy calculations on many cylinder problems. It calculates pressure, size of cylinder, horsepower, size of pump required, stroke time, etc. It's free for the asking. Write for yours.

Write for these two Hanna Cylinder Catalogs. No. 230 covers low pressure cylinders. No. 233 air pressure intensifiers. They will prove to be very helpful.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

1797 Elston Avenue, Chicago 22, Illinois

A coating for methyl methacrylate

Out of wartime needs for speed in production came this simple, inexpensive protective coating for methyl methacrylate which banishes the danger of the surface of the transparent material being damaged during fabrication and assembly

DEVELOPMENT of a protective coating which could be easily applied and easily removed became the object of a series of experiments undertaken by Ford Motor Co. engineers at the Willow Run Bomber Plant soon after B-24 Liberators went into quantity production. The success which attended their studies simplified and speeded up bomber manufacture and should prove beneficial in the fabrication of acrylics into civilian products.

In developing some kind of a protective film for the plastic windows of the bombers, Ford engineers literally started from scratch. They drafted the end specifications for the material yet to be developed, and set about creating a material to meet the specifications. In addition to the protective feature of the coating still to be compounded, Ford engineers were faced with the necessity of developing a covering that could be easily removed from the plastic nose of the ship just prior to completion of the job. As visioned, this coating would take with it any dirt, filings, lint or other waste material, thereby eliminating the possibility of scratches in the final polishing operation.

Several coatings were tried. One was a 2-coat material, the alcohol-soluble base being sprayed first directly on the plastic. After a 10-min. drying in moving air at 95° F., a top layer of lacquer was sprayed on. While the resultant film was resistant to paint, gasoline and water it was found to adhere poorly and to have a tendency to brittleness. Also, a slight crazing was noticed when the plastic was loaded at 2000 p.s.i. flexual.

Earlier a latex and paper spray film had been attempted but the difficulties of application and removal quickly eliminated it from consideration. Another disadvantage of this coating was that the opaque film materially hindered work on the airplanes.

A 20 percent solution of vinyl alcohol in water plus emulsified wax was abandoned when it was found to leave a greasy smear on the plastic surface. A similar mixture from which the wax was eliminated gave somewhat better results. However, this film was found to contain numerous small air bubbles and to possess such a great surface tension that it literally pulled itself away from the plastic, leaving occasional bare spots.

The test with the second solution, however, seemed to indicate that progress was being made. The film was applied in two brush and two spray coats, a procedure which materially extended the time of manufacture.

Dipping was then tried as a method of application. The film proved to be stringy and uneven and pulled away from the surface of the methacrylate on drying. To correct this tendency, 1 percent of a 10 percent aerosol solution in alcohol, a wetting agent, was added. The result was a film of uniform thickness.

An acceptable formulation

Three basic formulas were then tested, the formulas varying in the amount and types of polyvinyl alcohol employed. These formulas were then mixed in varying proportions and the results studied.

Samples were sprayed with zinc chromate primer, followed by neutral gray. Some were placed in an oven at 95 to 105° F. for 18 days. Others were placed in an ovenometer at 95°

Were it not for the protective vinyl coating on this acrylic plane window, its surface would be marred from contact with extension cords and tools during fabrication

The protective film covering, usually 0.0008 in. thick, is salvaged after removal from the acrylic plane window and returned to the dipping tank for further use

ALL PHOTOS, COURTESY OF FORD MOTOR CO.

Bend-A-Lite Is a "War Graduate" with a Proven Performance Record

When the Navy wanted range-finder dials for submarine radar in a hurry, demanding "obnoxiously close" tolerances, we took the job as a routine matter . . . turned the stuff out fast, too, when others said: "It just can't be done." With similar speed and facility, we have met other needs for a great variety of products.

On any type of precision fabrication . . . display fixtures . . . furniture . . . the fabrication of cast phenolics . . . radio cabinets . . . jewelry . . . or whatever has to be done beautifully and done right . . . you can depend upon Bend-A-Lite.

A letter or phone call will have the same kind of attention we give to quality production.

BEND-A-LITE

Plastics Division

423 SOUTH HONORE ST. • CHICAGO 12

The protective vinyl coating is applied to plastic parts by dipping. A tong-hold in one corner enables the operator to completely immerse the part in the solution

The ease with which this water-soluble vinyl film can be removed is one of its advantages. The coating is colored to insure removal before the plane is inspected

F. for 96 hours. The coatings could be removed easily after these tests, and the surface of the plastic was not affected.

A mixture of two parts of one of the basic formulas and one part of another was found by test to give the best results. Ford engineers settled upon this formulation as standard. The tests and experiments were conducted in the winter time. It was found that, on standing, the mixture yielded a film which was less elastic than the samples which had been produced in the laboratory. The difference in elasticity was attributed to the lower humidity of the air in winter time, and glycerin was added as a plasticizer to form a modification of the standard formula.

As finally specified—making allowance for the degree of humidity encountered at the time of application—the basic formula (for one gallon) is as follows:

Amount	*Material*	*Cost*
1.13 lb.	RH623 polyvinyl alcohol	$0.74
0.36 lb.	RH488 polyvinyl alcohol	0.23
0.93 lb.	Water	...
0.013 gal.	M-1044 denatured alcohol	0.01
0.008 lb.	Aerosol 100 percent pellets	0.02
0.003 lb.	Methyl orange dye	0.01
0.026 gal.	M-1162B glycerine	0.02
		$1.03

Applying the accepted coating

As applied in the Willow Run plant the process is a simple one. Stock sheets of acrylic are cut to form through template markings. The protective paper covering is then removed, and the sheets are cleaned and placed in an oven where they remain for 10 min. in a temperature of 250° F. The sheets, thoroughly pliable upon removal from the oven, are placed on flannel-covered forms and molded to shape through the use of weighted frames. In this operation the operators wear flannel gloves so that they will not mar the smooth surface of the plastic.

When the acrylic has cooled to shape, it is dipped in a tank containing the polyvinyl coating solution which is maintained at room temperature. The pieces are then hung on a rack to dry. Drying is accomplished in an enclosed area which has infrared lights and special fans to speed the process. Excess coating drips on to pans below the drying racks. When the pieces have dried they are removed. The tong-hold, where a spring clip held the sheet in place on the drying rack, is then painted over with the same protective coating. When the brush patch dries the part is ready for the machining and handling necessary for installation.

Stripping the finished sheet

Removal of the film is ordinarily accomplished by breaking it with the thumbnail at the center of each window and peeling it toward the edges of the formed plastic sheet. This method eliminates the danger of any aluminum chips, filings, etc., contacting the plastic surface. If the relative humidity at the time of film removal is much lower than was anticipated when the coating was applied, the coating may become so hard that its peeling characteristics are impaired. When this occurs, the elasticity of the film can be restored by spraying the protected plastic enclosure with a very fine mist of water, using a regular paint touch-up spray gun. There is a wait of 30 min. to allow the moisture time to penetrate the film and the excess water time to evaporate.

This humidifying treatment restores the film's elastic properties and the coating can then be readily peeled off. The excess coating that drops off the acrylic into the drying rack can be recovered and used again. The film has an average thickness of 0.0008 inch.

This technique of removal was evolved only after several unsuccessful experiments had been attempted, not only with the polyvinyl film but with other coatings as well. In the course of these trials, several removal agents were tried with disappointing results for it was found that the agents which would dissolve the protective film would becloud the surface of the methacrylate to such an extent that the result was worse

Speed Production!

ELMES

Put Your Pressing Problems up to ELMES

for BETTER WORK
★ LONGER RUNS
★ LOWER COSTS

HYDRAULIC EQUIPMENT

Elmes self-contained cabinet-type plastics molding press. Automatic time cycle. Push-button control.

●

Elmes ultra-rigid hobbing press. Pressure in millions of pounds is delivered with precision accuracy.

The *"tomorrow"* of yesterday has arrived! An expectant world looks forward to the Age of Plastics. A multitude of versatile molding compounds are already developed, and there will be many more, but *molding costs* must be favorable, too, in the future which lies ahead.

Molders who do better work, *faster* and with *fewer rejects* . . . who set high schedules, and *maintain* them . . . who can depend upon equipment to *"take it"* day-in and day-out . . . know that costs will be *low,* business *good.* In tomorrow's production, quality and economy must go hand in hand.

For nearly a century, Elmes hydraulic equipment has been famous for *cutting costs.* Elmes simplified controls bring instant response for speedy, accurate operation. Elmes craftsmanship is apparent in every detail, in every "plus" that means *lower* maintenance, *longer* life.

Let this experience be your guide to *progress*—to performance at its *best.* "Put Your Pressing Problems up to Elmes."

Elmes column-type molding press, a fully automatic, self-contained, special design for deep molds, thin sections.

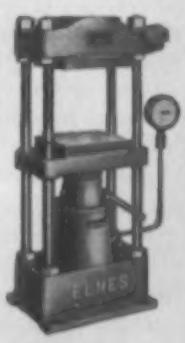
●

Send for Bulletins on Presses, Pumps, Accumulators

LABORATORY PRESSES

Convenient and capable production tools for short runs and small jobs.

Excellent for pre-testing new molds—for determining temperature, curing time, and pressure—for testing specimens—speeding research. 20-ton press, at left; 30-ton at right.



ELMES ENGINEERING WORKS *of* AMERICAN STEEL FOUNDRIES, 225 N. Morgan St., Chicago 7

Also manufactured in Canada

METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

than scratches. The water process was almost too simple to be believed.

A wide field for application

Though the present formula is regarded as satisfactory for the purpose for which it was developed, Ford technicians foresee the possibility of widening the uses of the film by the addition of various agents to meet specialized conditions. To this end, experiments are even now under way. Also included in present experimentation is the use of other blends of polyvinyl alcohols with varying percentages of other plasticizers.

The postwar uses of the coating are not necessarily restricted to plastics. One field of suggested use is in the protection of plated parts where a slight surface scratch is sufficient to spoil the entire part.

Attached is a record of comparative tests made in the Ford Willow Run laboratories which gives a comprehensive account of the tests of the various methods of protection employed in 1943 in the handling of methacrylate. In the ratings quoted, 10 is the top or best rating.

	Latex and paper	*One of the widely used coatings*	*Ford Protecto-kote*
Solvent resistance			
Gasoline	2	10	10
Sunoco	2	10	10
Alcohol	0	0	8
Ethyl acetate	0	3	8
Water	9	8	0
Crazing effect of wet film on stressed Plexiglas	10	7	10
Paint resistance	8	10	10
Elasticity	10	4	10
Adhesion	4	10	8
Film hardness	0	7	10
Transparency	0	7	10
Material cost	0	1	10
Labor cost	0	4	10

Ethylhexyl phthalate

(*Continued from page 170*) fined to these resins. It has special uses with numerous other resins and is compatible with still others.

Vinyl chloride-acetate resins have been the subject of some of the more extensive plasticizer researches, and it is for this reason that so many of the characteristics of plasticizer DOP have been determined with respect to these resins. Cloth calendered with a vinyl chloride-acetate resin which has been plasticized with this plasticizer will not support fungus growth under any conditions. Plasticizer DOP also reduces the pressure and time for sealing seams of this plastic, or cloth coated with it, at a given temperature. Further indications are that DOP-plasticized film will be three or more times as resistant as some other films to stiffening in soapy water, as might be encountered in shower curtain service.

In vinyl-chloride resins dioctyl phthalate is essentially permanent, provides good low-temperature flexibility, and is resistant to extraction by water.

For average applications of cellulose nitrate where great permanence of plasticizer is desired, plasticizer DOP is recommended. The choice of plasticizers will depend upon various factors, among which are the permanence of flexibility desired, and the need for low temperature flexibility, pliability and tensile strength.

Proximity fuze

(*Continued from page 136*) viscosity permits easy flow.

Most of the vinyl cases were molded on 4-oz. injection machines. The Cliderite walls, molded on hand-made presses, could be turned out at the rate of one every 15 seconds.

The top and bottom of the battery are sealed with molded phenolic or laminated terminal wafers with metal connectors inserted then sealed with vinyl resin or the potting compound, and placed in a metal can that is crimped for sealing.

The battery core

Perhaps the most interesting part of the battery to molders is the contents of the core or center of the battery. This core contains a ribbed, elastomeric vinyl thimble which acts as a container for the glass ampule in which the acid is carried. This thimble is one of the prize molding jobs of the industry. Many a molder gave it up, only seven completing the job.

The material is elastomeric vinyl type VG-1947 Bakelite. The specifications were as follows—length, 1.680 in. ±0.005 in.; bottom thickness, 0.035 in. ±0.005 in. with a tiny phlange. The temperature for molding in the laboratory was around 300° F., but in actual production it varied according to the machine used. If the temperature was one degree more than was necessary, the material would stick or burn. The only way to avoid such a casualty was to use care in maintaining uniform heat and pressure. A split mold was used with an air hose attached to remove the thimble from the cavity.

One molder finally succeeded in using a 10-cavity mold but no one would believe it until they saw it because of the difficulty involved in forcing an even flow of elastomeric material into cavities that were built for these paper-thin-side-wall thimbles. The most generally accepted method was to use 4 cavities on a 4-oz. machine using a half ounce of material per shot. Anything smaller than a 4-oz. machine did not provide enough pressure.

In addition to the thimble container the core of one battery model also contained a Tenite II cradle upon which the glass ampule rested. This cradle called for a ±0.005 in. tolerance. There was also a metal stud which pierced the glass, a Bellevill spring, a spring seat washer and a shield plate.

An important aid in the production of this battery was a new thermoplastic potting compound which has been patented under the name of "Cliderite." It consists largely of ethyl cellulose flake and certain waxes, and was developed through the collaboration of Hercules Powder Co., Ernest Bischoff and Johns Hopkins University. Danger of leakage of acid from the battery and the impossibility of finding a wax that would adhere to the plastic parts of the battery in order to seal it, led to research and study that finally brought out this material. Its high viscosity is particularly helpful in closing minute openings. It has proved successful as an insulator for high voltage or high and low frequencies. It adheres to metal as well as to plastics, which makes it good material for the assembly line, especially where lead wires have to be bent to make connections and can replace wax over wires because it adheres and prevents moisture penetration. It has been investigated as a shock absorber material for glass tubes and for interior linings as a protection against alkalies. Among possible postwar suggestions for this potting compound are waterproof marking crayon, cable insulation, flashlight seals.

The complete battery has untold possibilities for postwar adaptations. Some companies already plan to use it in miniature radio sets. Others will undoubtedly study its application in products that require a small battery.

Adhesives and adhesion

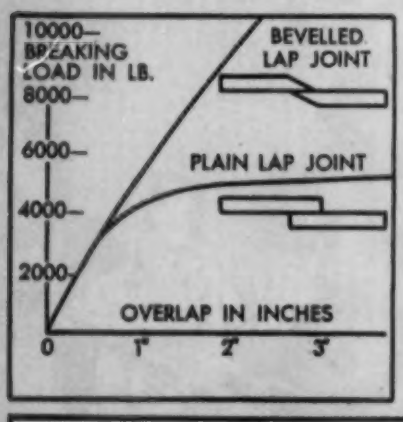
(*Continued from page 168*) tool shown in Fig. 11. It consists in rigidly clamping the outer sections of the specimen in the shearing tool and applying a compressive load upon the shear member which applies an evenly distributed load to the central portion of the specimen. It is necessary that the two glue lines be accurately placed in the shearing planes of the instrument; thus very careful machining of the specimen is required for reproducible values.

The cylindrical double shear test used by McBain[14] is similar to the Johnson shear test. The essential difference is that the cylindrical specimen is broken by a tensile load. The grips and specimen for this test are shown in Fig. 12.

Each of these tests has disadvantages; some give poor reproducibility and others require a high degree of accuracy in machining. The reasons for poor reproducibility may be illustrated by considering the single lap joint specimen. It has been shown[49] that stresses applied to such a specimen are not equally distributed over the entire glue line, but are concentrated near the ends of the overlap (See Fig. 14).

This unequal stressing is due to the shape of the test piece rather than the means for applying the load. A given load will be concentrated excessively at the ends of each member on the overlap and very slightly on the exact center of the glued area. The result will be a partial shear failure and a partial peeling action. The shear value obtained in this way will not be directly proportional to the area of the overlap, but will reach a maximum value after which increasing the area will not change the shear value.

De Bruyne has found, however, that by tapering the ends of the overlapped sections, the shear value will become proportional to the area. A comparison of shear breaking loads obtained by these two methods is presented in Fig. 13.



13—*Shear strengths of both tapered and untapered lap joint specimens. (From deBruyne)*

It is shown in Fig. 10 that a similar modification of the double lap joint eliminates even more of the distortional error.

Shear methods based on torsion have not been investigated to any extent. These methods are also hampered by the problem of non-uniform stress distribution over the entire glued area. A rigorous consideration of the stress problems in shear testing has been presented by Goland and Reissner,[50] and also by Hearmon.[51]

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N.A.C.A. Technical Note No. 989 contains a list of over 500 reports published by technical journals aircraft manufacturers, adhesive manufacturers, and Government laboratories on the subject of adhesives. References are also cited for recent patents in this field issued in the United States, Canada Australia, Great Britian, Belgium, France, Holland, Switzerland, Russia, Germany and Japan. A copy of the complete report can be obtained from the National Advisory Committee for Aeronautics, Washington, D. C. The first 33 references appeared in the October 1945 issue of MODERN PLASTIC with the first half of this article.

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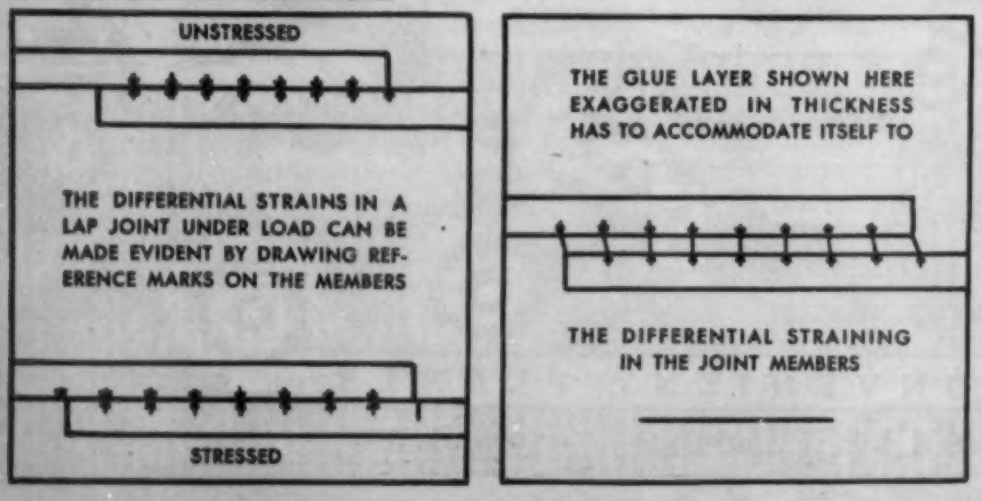


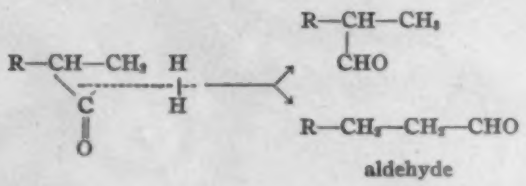
14—*Concentration of stress due to a differential strain in a lap joint specimen. (From deBruyne)*

New synthesis of acrylic acid

(*Continued from page 163*) with acetylene can also be realized with the olefins by the use of stoichiometric quantities of metallic carbonyls in the presence of acids as well as purely catalytically.

At present we are working on the catalytic synthesis of carboxylic acid esters based on the higher olefins, because we visualize in this a simple means for a useful synthesis of fatty acids and alcohols. In discontinuous production the yields are almost quantitative. The experiments on the continuous production of fatty acids and alcohols by this method are not yet completed.

Lately a process of the Ruhrchemie A.-G., the so-called oxo-synthesis, received a great deal of publicity. As you see, this reaction falls into the complex reaction system which we are discussing. It is explained, as you can see from the diagram, in the following way:



The intermediate cyclopropanone ring is split by hydrogen itself instead of compounds with labile hydrogen atoms, thus forming aldehydes which can be converted into alcohols by further hydrogenation. Unfortunately, Ruhrchemie got ahead of us here, although on the basis of wholly different observations. In the course of our further investigations of the olefins which had only been under way for three months at that time, we could not have missed the oxo-reaction, particularly since we had already observed that fatty alcohols are produced quantitatively and directly by the reaction of olefins and metallic carbonyls in the presence of acids.

We consider our work in the carbonyl field, which we have presented to you, only as the beginning of our investigations on the application of the very interesting metallic carbonyls in organic chemistry.

Strangely enough, the chemistry of the metallic carbonyls has so far been explored only by the inorganic chemists, with a few exceptions described in German Patents 441,179 and 565,977 which deal with the reduction of organic compounds and especially with the production of leuco compounds by means of metallic carbonyls.

The possibilities which metallic carbonyls offer to organic chemistry can be seen from the fact that by heating nickel carbonyl with acetylene in the presence of a solvent—e.g., toluene, paraffins, or olefins, such as octylene—we have succeeded in obtaining in a relatively smooth reaction hydrindone, which one has to visualize as being constructed of 4 molecules of acetylene and 1 molecule of carbon monoxide. Aldehydes and ketones also react strongly with acetylene in the presence of metallic carbonyls and acids, but the course of this reaction cannot yet be completely explained.

It can be expected with certainty that carbonyl chemistry will provide a completely new tool for organic chemistry and will yield many beautiful contributions on the synthesis of comparatively complicated materials from simple building stones.

Polyvinylpyrrolidone

(*Continued from page 161*) *the k-value*—The abnormal positions of the conjugated points[5] can be explained from the three-dimensional representation of nonmiscibility as related to the *k*-value (Fig. 12).

Our polymerization always produces to a greater or lesser degree mixtures of polymers with varying *k*-values and the two phases contain Kollidons of different mean *k*-values. Therefore, the conjugated points, according to the degree of inhomogeneity, are situated more or less above or below the surface representing nonmiscibility on the nonmiscibility solid shown in Fig. 12.

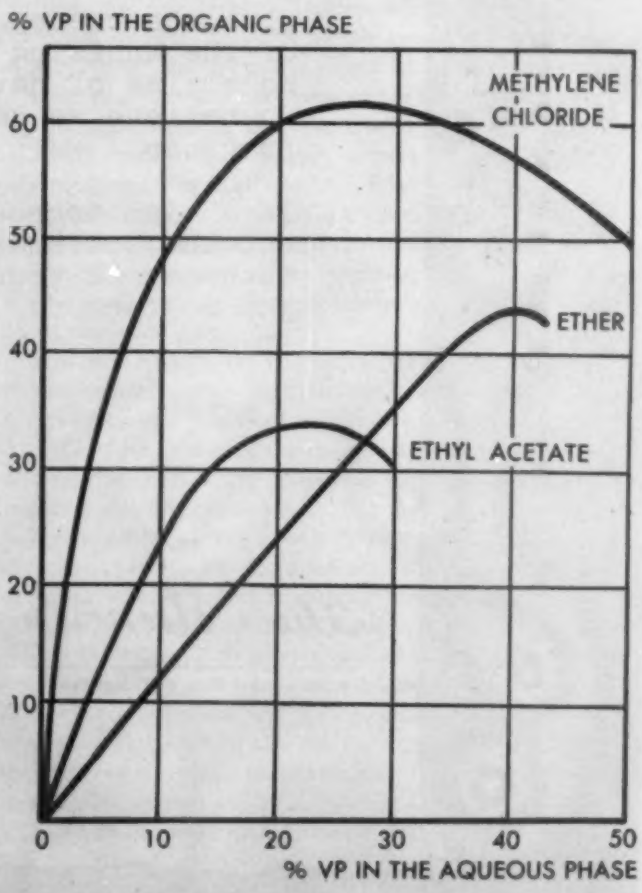
The connecting lines of the 3 points, which in normal nonmiscibility in ternary systems would be situated on straight lines, are in this case probably three-dimensional irregular curves.

Fractionation of the Kollidons—This is an explanation for the possibility of precipitating the Kollidons from aqueous solutions with acetone into fractions of varying *k*-values, which was first pointed out by Dr. Hecht of Elberfeld.

With an exact knowledge of the nonmiscibility one can fix the optimum conditions for the fractionation. In order to separate by fractionation, for example, the low-viscosity component from Kollidon F 33, one has to start with a relatively concentrated, aqueous Kollidon solution (about 30 percent) and mix this solution with an equally concentrated solution of Kollidon in acetone in the proportion of 1:3.

Because the position of nonmiscibility varies with the *k*-value (Fig. 12), it is possible, especially in the range of low

[5] We are indebted to Dr. Frombers, Oppau, for his advice on the theoretical part.



9—The distribution of VP between water and organic solvents at 25°C.

Practically all of the standard types of equipment that have been adapted to the manufacture of plastics are equipped with Timken Tapered Roller Bearings and—have been for many years.

More and more attention is being given to the application of Timken Roller Bearings to machines designed especially for the production of plastics.

One of the most important points for the application of Timken Roller Bearings is on the roll necks of plastics rolling mills. Another is in mixers, where accuracy and endurance are essential. By eliminating friction; preventing wear; carrying radial, thrust and combined loads and assuring correct and constant alignment, Timken Bearings save power, simplify lubrication, cut maintenance cost and prolong equipment life.

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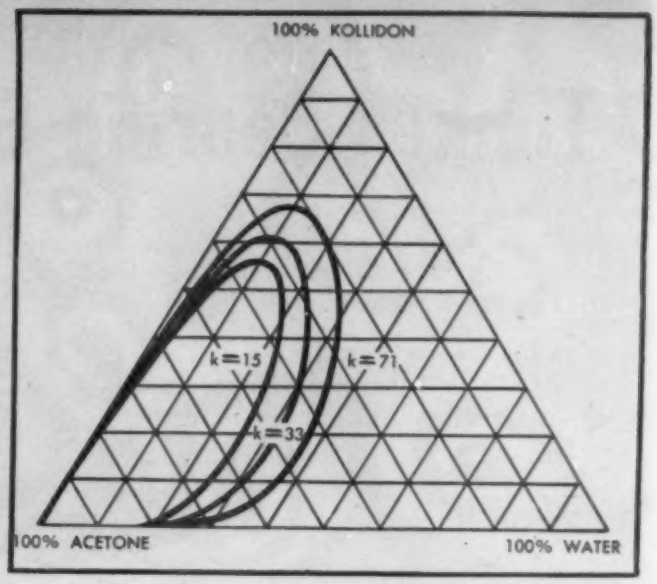
TAPERED ROLLER BEARINGS



10—*Nonmiscibility of the system Kollidon /acetone/ water at 25°C. for Kollidons of various k-values.*

k-values, to determine the *k*-values by titration of aqueous solutions with acetone.

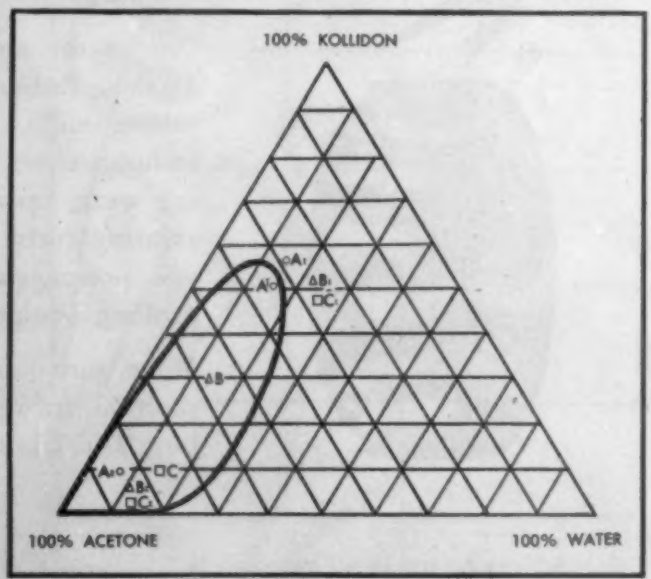
Chemical properties—The investigation of the chemical properties of the Kollidons is not yet completed. During polymerization there probably occurs a reaction between the hydrogen peroxide and the end group of the polymer chain, forming acidic carboxyl and hydroxyl groups. Films of the Kollidons can be made insoluble in water by treatment with cross-linking diisocyanates.

V. Applications of the Kollidons

The first application was the use of the low-viscosity block-polymerized polyvinylpyrrolidone as a blood substitute liquid (Periston) in the form of a 2.5 percent aqueous solution.

Advantages of such solutions compared with stored blood are that one is independent of the blood groups and that these solutions have practically unlimited stability, even without refrigeration.

The Kollidons are of interest as bonding agents in the film, reproduction and coating industries, as well as for glues,



11—*Nonmiscibility of the system Kollidon (k-15) /acetone/ water at 25°C., showing conjugated points*

Obviously this dog owner didn't expect such great strength in a lightweight. That combination is unusual in canines—or in materials.

KYS-ITE offers it, however. And throws in several other "rarely-found-together" properties no other type of material combines. With these marked advantages, no wonder KYS-ITE users confidently face the competitive days ahead.

GREAT STRENGTH WITH LIGHT WEIGHT

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Unusually durable and resistant to abrasion, impervious to mild alkali and acid solutions.

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KYS-ITE's lustrous finish is highly durable; the color is an integral part of the material itself. A wipe and it's bright!

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KYS-ITE's dielectric properties make it invaluable where safety is a factor. Also a non-conductor of heat. Non-resonant and non-reverberating.

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The extensive demand for KYS-ITE won't allow us to take further specialty orders at the moment. The lifting of restrictions has improved this situation, however, and we hope it won't be long before we can say, "We're ready for you now."

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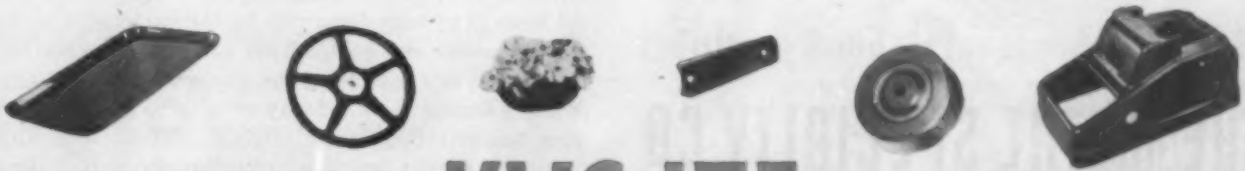

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Preformed Plastic Combining Long-Fibered Wood Pulp and Synthetic Resin

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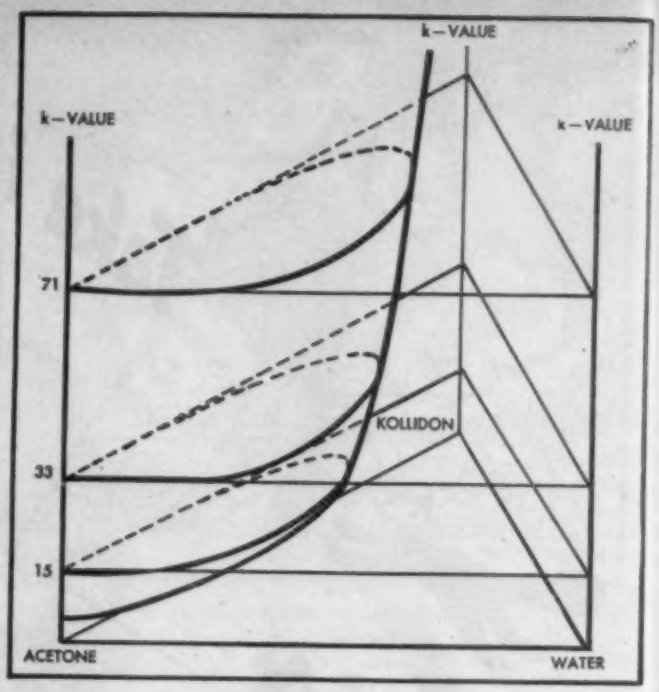

12—*Nonmiscibility of the system Kollidon/acetone/water at 25°C. in relation to k-value*

label and rubber adhesives; a raw material for adhesives; and as thickening agents for emulsions and solutions. As sizing agents for paper, fibers and fabrics, the Kollidons have special effects, particularly in combination with basic dyes to bring out a deeper color tone.

Although the production of polyvinylpyrrolidone requires a number of steps, the production cost will, on account of the cheap raw materials (acetylene and formaldehyde) probably not be excessive.

The amount of this polymer produced to date in the Technical Laboratory for Pharmacology in Elberfeld is 3.4 tons.

The preparation of the solution polymers can be conducted in any amount in machinery already on hand.

Our experimental Nubilosa dryer has a capacity of about 100 kg. of Kollidon F (solid) per day.

VI. Summary

The polyvinylpyrrolidones represent a completely new type of polymerization product in that they are soluble in both water and organic solvents.

Today, they can be commercially produced without any difficulty in aqueous solutions in viscosity grades ranging in *k*-values from 5 to 100. The addition of ammonia strongly activates the polymerization reaction.

The exact investigation of the reaction conditions in the polymerization process (latent period and polymerization velocity) and the properties of the polymers (*k*-value) resulted in many surprises which can probably be explained on the basis of hydrate formation by the monomeric as well as the polymeric vinylpyrrolidone. In this category belongs the strange, first increasing and afterwards decreasing, course of the polymerization velocity with increasing vinylpyrrolidone concentration in the original mixture, with little influence on the *k*-value; the strong acceleration of the polymerization velocity through increased amounts of ammonia; the decisive influence of the added amount of hydrogen peroxide on the *k*-value; and the relatively minor influence of temperature on the *k*-value.

The investigation of nonmiscibility in ternary systems re-

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vealed for the first time the correlation between the extent of nonmiscibility and the *k*-value. This presents a possible means for the separation of nonhomogeneous polymers into fractions with high and low *k*-values and the determination of their absolute values. The conjugated points of such polymers are not situated, as might be expected, on the nonmiscibility curve but above or below this curve on the surface of the nonmiscibility solid which corresponds to the whole *k*-value range.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933, OF MODERN PLASTICS, published monthly at Easton, Pennsylvania, for November 1, 1945.

State of New York } ss.
County of Kings }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Chas. A. Breskin, who, having been duly sworn according to law, deposes and says that he is the Publisher of the MODERN PLASTICS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:
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Editor, Chas. A. Breskin, 122 E. 42nd St., New York City.
Managing Editor, Laura E. Morrison, 122 E. 42nd St., New York City.
Business Manager, A. S. Cole, 122 E. 42nd St., New York City.

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CHARLES A. BRESKIN, Publisher

Sworn to and subscribed before me this 4th day of October, 1945.

[SEAL] HERMAN L. ISLER
Notary Public, Kings County

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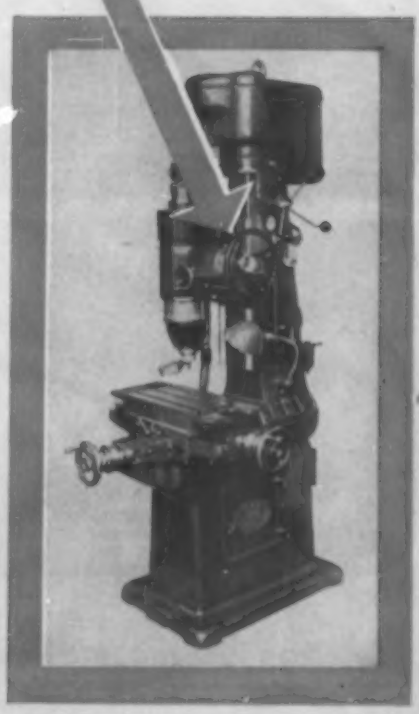

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It Holds Everything!

ALL of those so-different materials in that swing are bonded by *one* adhesive!

It's Pliobond . . . that revolutionary, new, quick-setting plastic adhesive . . . developed by American industry to solve wartime production problems. Pliobond solidly joins any materials . . . like or unlike . . . metals, plastics, fabrics, glass, rubber, wood, paper, plaster, leather, concrete, etc.

With Pliobond most applications need no high pressure or heat. For exceptional high shear strength, moderate pressure and 200-300°F. heat are sufficient.

Other important characteristics of this remarkable new adhesive: it's strong . . . permanent . . . withstands constant flexing . . . sets quickly . . . is immune to fungi . . . resists water, oils, and wax.

And Pliobond is always ready to go to work. Because it is a *one*-part bonding agent, there are no fussy mixtures . . . no exact weighing . . . no critical temperatures. It can be brushed, sprayed, spread or roller coated.

Don't these amazing features give you ideas toward solving production problems? Write us for full technical information on any application you have in mind.

Pliobond

BONDS ANYTHING TO ANYTHING!

★

UNITED STATES PLYWOOD CORPORATION

Exclusive Distributors

Industrial Adhesives Division: 55 West 44th Street, New York

Branches in Principal Cities

PLIOBOND® is a product of

THE GOODYEAR TIRE & RUBBER COMPANY

®Trademark registered, The Goodyear Tire & Rubber Company

Pliobond for Home use will soon be available at your neighborhood store

Electronics

...boy wonder with a man-sized headache!

This miracle—so called—is not new; merely its maturity has been abnormally progressive under the stimulus of war. Assuredly, electronics is destined for an even greater place in every day life. Highly touted, however, the uninitiated have placed it on a pedestal tending towards absurdity.

Down-to-earth electronics *will* shine in the future. While research may never fulfill the exaggerated claims of present thinking, solutions will be provided for many persistent problems. If manufacturers and designing engineers do the job harmoniously, resourcefulness can be the antidote for over-optimism.

Plastic moldings can offer definite advantages in the production and functioning of electronics components. But, by the same token, they certainly do not provide "seven league boots" or "cure-all" attributes for poorly designed product conceptions.

The new MACK MOLDING 8-page brochure will help to clarify the position of plastic moldings in industry. Write for your copy today, to Mack Molding Company, Inc., 120 Main Street, Wayne, N. J.

Mack MOLDED EXCELLENCE

SALES OFFICES: NEW YORK CITY, CHICAGO, DETROIT, INDIANAPOLIS, BOSTON & ST. LOUIS

Who sets the *Quality Standard* FOR TRANSMITTING TUBES

WERE it possible, within the limits of this page, to show you all the numerous operations required to construct United Tubes, you would realize why the name United means Quality Standard for transmitting tubes. For the sterling quality of United Electronic tubes is born of a series of unique manufacturing processes vigilantly guarded by Quality Standard Tests. Many are standard procedure; many more are exclusively United features. Those illustrated represent a few of the extra operations which help maintain leadership for United.

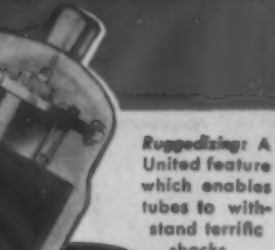
Since 1934 United has won recognition by specializing exclusively in the engineering, designing and building of transmitting tubes which are unchallenged for excellence. That is why, with each succeeding year United tubes are used *more and more in important places.*

Write for a copy of our latest catalog.

ABOVE. No machine can rival the skill of human hands in fitting the precise parts of Electronic Power Tubes. These are the hands of craftsmanship building sterling quality into United Tubes.

***QST-1**—In this United Comparator grids are carefully checked. The slightest variations in grid wire spacings would affect tube characteristics and performance. Critical tolerances are strictly adhered to, and any deviation from precision standards is revealed on the greatly enlarged grid image.

QST-2—Every thoriated tungsten filament is carburized in a controlled atmosphere chamber to enhance its emitting qualities. It is an added step that assures accurate filament current and maximum emission. This is but one of many procedures that contribute to the dependable performance of United tubes.



QST-3—The tell-tale colors of any glass strains are detected in time by this United Polariscope so that all possibility of glass fatigue is obviated.

*Quality Standard Test

Masterpiece of Skilled Hands

Ruggedizing: **A United feature which enables tubes to withstand terrific shocks.**

UNITED

ELECTRONICS COMPANY

NEWARK, 2 NEW JERSEY

Transmitting Tubes EXCLUSIVELY Since 1934

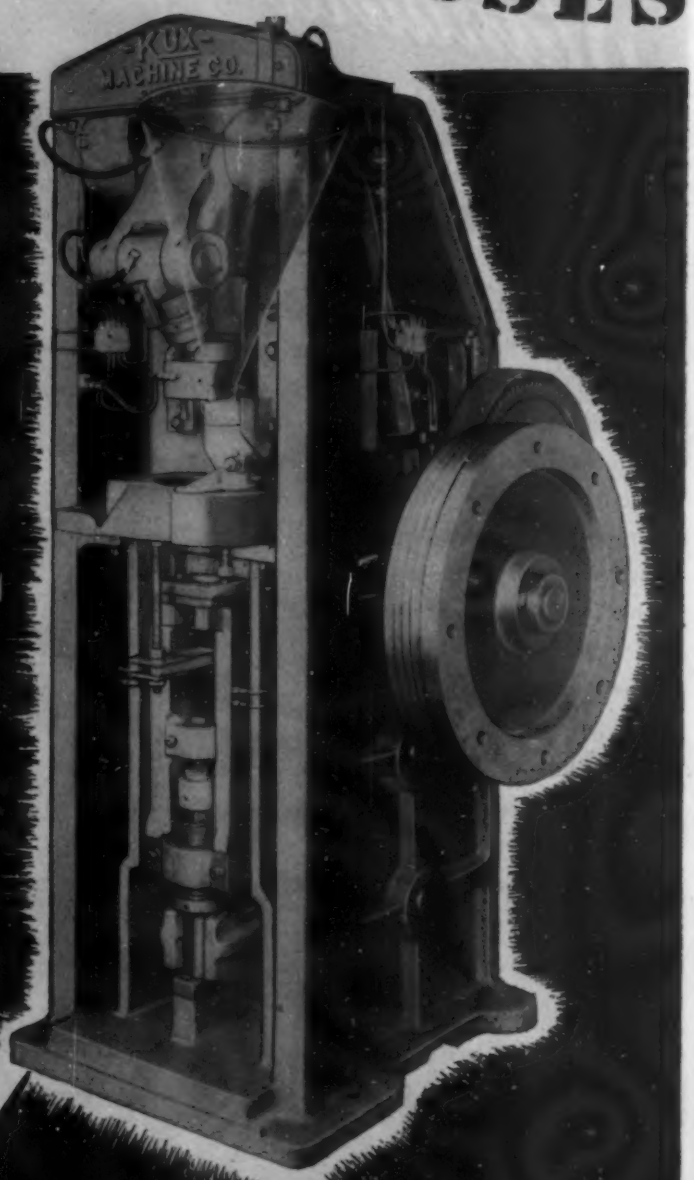
STURDY

KUX PREFORM PRESSES

The new massive Model 65 produces preforms 3" diameter, has a 3" die fill and applies 75 tons pressure

This rugged preform press with its heavy duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.



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KUX MACHINE COMPANY

3924-44 WEST HARRISON STREET • CHICAGO 24

MAKE YOUR OWN TEST →

Write for Your Sample Today

Creative minds in laboratories everywhere are searching out the peacetime uses of cotton cellulose.

This superior cellulose is being successfully used in scores of products requiring a cellulose of unusual purity and cleanliness.

EXPERIMENT NOW

Research chemists, designers, engineers, and others interested in the present or future manufacture of products made from cotton cellulose, may now obtain CHEMCOT for EXPERIMENTAL PURPOSES. We shall be glad to send, without cost, enough CHEMCOT to determine, through laboratory tests, the effectiveness of its use in your product.

We want to know of your problems and needs. High quality CHEMCOT fits individual requirements and meets the most exacting specifications. It is manufactured in both bulk and sheeted form.

WHY CHEMCOT IS A BETTER BASE FOR BETTER PRODUCTS

- Purer form of cellulose produces stronger yarns and films . . . more strength, better color and clarity in plastics.
- CHEMCOT has an average alpha-cellulose content of 99% plus, assuring strict conformity to rigid specifications.
- Furnished in two forms (bulk and sheeted), having a wide variety of adaptations.

WE DO NOT MANUFACTURE FINISHED PRODUCTS, BUT PRODUCE PURE COTTON CELLULOSE FOR USE IN A WIDE VARIETY OF PRODUCTS.

CHEMCOT
PURE COTTON CELLULOSE

A FEW PRODUCTS MADE FROM CHEMCOT

ADHESIVES
CASINGS, SAUSAGE
CELLULOIDS
COATING AGENTS
COTTON, ABSORBENT
DIAPERS, DISPOSABLE
DYNAMITE
FIBRES, VULCANIZED
FILMS
FILTERS
FINISHES, TEXTILE
FLOC (SUEDE FINISHES)
FOILS, TRANSPARENT
GLASS, NON-SHATTERABLE
INSULATION
LACQUERS
LAMINATED PRODUCTS
LEATHER, ARTIFICIAL
LINOLEUM
NAPKINS, SANITARY
PAPER
PAPER-PRODUCTS
PLASTICS
POLISH, NAIL
POWDER, SMOKELESS
RAYON YARNS

If your product is included in this group, or if you are interested in the manufacture of a product from cellulose, you will want to know more about CHEMCOT.

SOUTHERN CHEMICAL COTTON COMPANY

CHATTANOOGA 10, TENNESSEE

SAFETY

FIRST:

Away with rejects! Leominster Injection Molder requires only one adjustment of One screw for precise die-alignment, preventing flooding.

SECOND:

Toggle-trouble is eliminated by full-length toggle pin support — and — "Centralshaft" centralized movable plate support assures equalized pressure distribution.

THIRD:

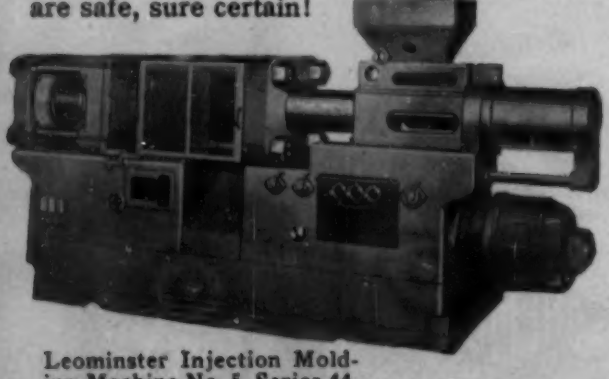
Machine cannot function when EITHER door is open, nor when either of the two independent safety factors becomes inoperative.

FOURTH:

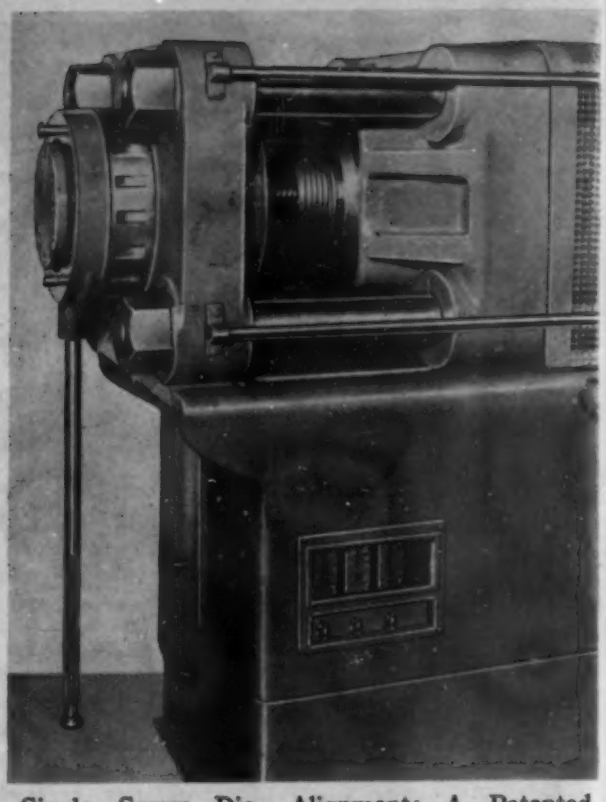
Ejection parts' erosion, cramping, breakage, are done away with by uniform thrust of the multiple knock-out pin assembly.

and FIFTH:

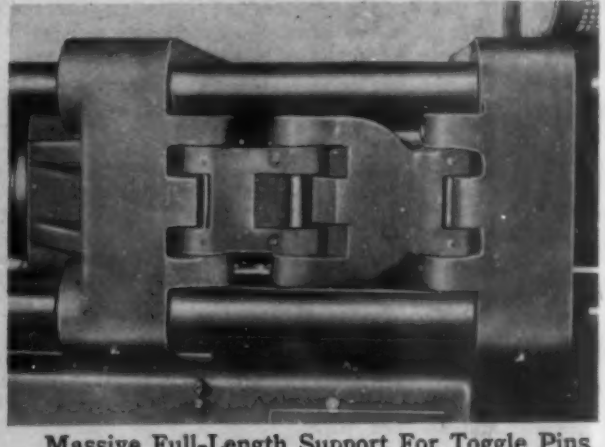
An efficient machine assures an efficient operator — each influences the other — for better production — and Leominster Molders are safe, sure certain!



Leominster Injection Molding Machine No. 5, Series 44.



Single Screw Die - Alignment; A Patented Leominster Feature.



Massive Full-Length Support For Toggle Pins

Leominster Injection Molding Machine No. 5, Series 44, termed "the molder with a brain" by plastics experts and operators, is one of a comprehensive line of plastics molding machinery produced by Leominster. May we send you a recent folder describing molds, molders and granulators?

LEOMINSTER TOOL CO., Inc.

LEOMINSTER, MASSACHUSETTS

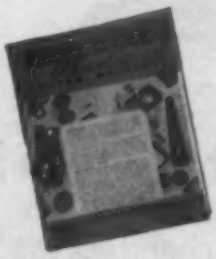
MANUFACTURERS OF MACHINES, TOOLS AND DIES FOR THE PLASTICS INDUSTRY

beginning A PLEASANT RELATIONSHIP

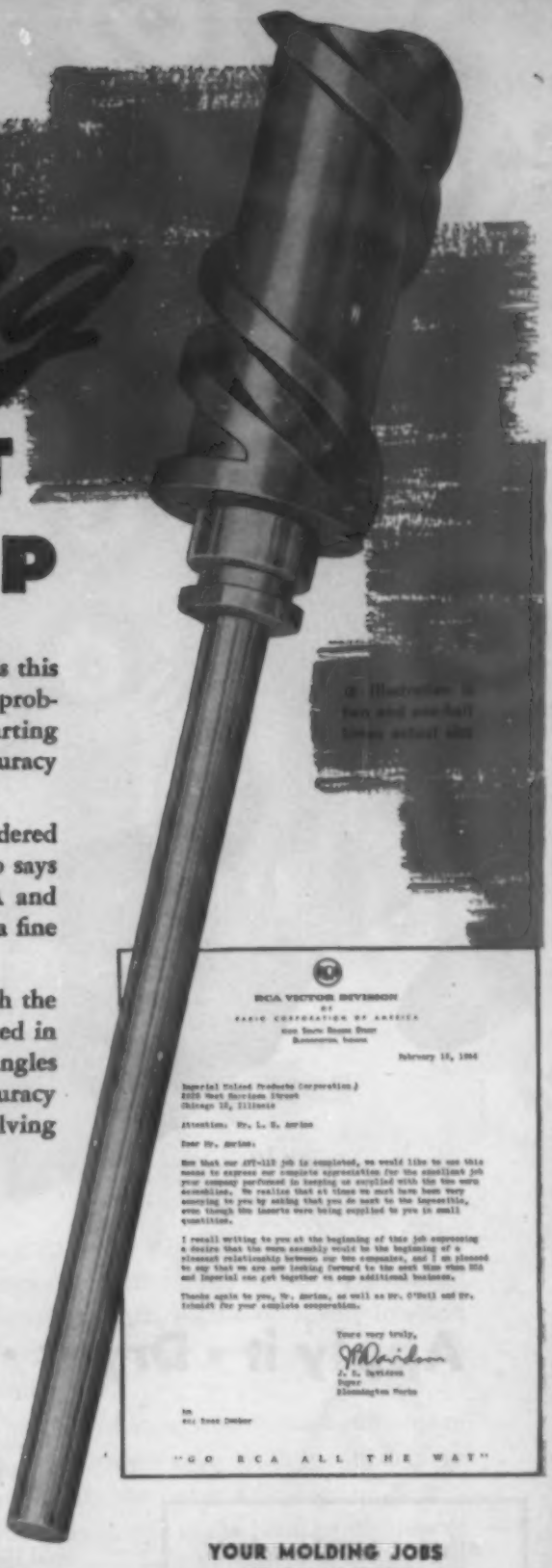
One of the many jobs being turned out at Imperial Molded is this worm assembly for RCA. It involved a number of interesting problems. Perfect spiral threads had to be maintained, with no parting line . . . positioning of insert had to be concentric . . . close accuracy was essential.

Produced under difficult wartime conditions, the service rendered was the subject of a fine letter of appreciation from RCA, who says ". . . we are now looking forward to the next time when RCA and Imperial can get together on some additional business"—truly a fine beginning of a pleasant relationship.

Imperial Molded is building many such relationships through the solution of tough molding jobs. Many of these jobs have resulted in new advances in compression molding techniques from such angles as handling of inserts, molding of threads and holding close accuracy on a commercial basis—advances which will aid materially in solving your tough molding jobs after the war!



• Bulletin K-200—with its helpful comparative table on the characteristics of various compression molded plastics and a brief picture story of how the Imperial molding plant operates—will be gladly sent on request.



RCA VICTOR DIVISION
OF
RADIO CORPORATION OF AMERICA

February 16, 1944

Imperial Molded Products Corporation
2927 West Harrison Street
Chicago 12, Illinois

Attention: Mr. L. S. Avrim

Dear Mr. Avrim:

Now that our ATT-112 job is completed, we would like to use this means to express our complete appreciation for the excellent job your company performed in keeping us supplied with the worm assemblies. We realize that at times we must have been very annoying to you by asking that you do sent to the impossible, even though the inserts were being supplied to you in small quantities.

I recall writing to you at the beginning of this job expressing a desire that the worm assembly would be the beginning of a pleasant relationship between our two companies, and I am pleased to say that we are now looking forward to the next time when RCA and Imperial can get together on some additional business.

Thanks again to you, Mr. Avrim, as well as Mr. O'Dell and Mr. Schmidt for your complete cooperation.

Yours very truly,

J. L. Davidson
Buyer
Bloomington Works

bm
cc: Home Number

"GO RCA ALL THE WAY"

IMPERIAL MOLDED PRODUCTS CORPORATION
2927 West Harrison Street, Chicago 12, Illinois

IMPERIAL
Plastic Molding

BAKELITE • PLASKON • DUREZ
NAKALOT • TENITE • BEETLE • LUCITE

YOUR MOLDING JOBS OF TOMORROW

Successful molding of intricate war parts today points to solutions for your tough molding jobs of tomorrow. While today the facilities of Imperial Molded are being devoted "all out" to war jobs, tomorrow the new developments in molding techniques will be available for your products.

Strip

a wartime technique!

The new way to package and protect

Apply it • Dry it • Store it • Ship it • *Strip* it!

Another invaluable war tool is now available. CORDO-FLEX is a synthetic plastic coating, *applied cold*, by spray, dip or brush. It air-dries in a few minutes; forms a perfect seal against water, oil and gasoline; protects surfaces against corrosion, abrasion, handling, harmful elements and the weather, while in storage or in transit.

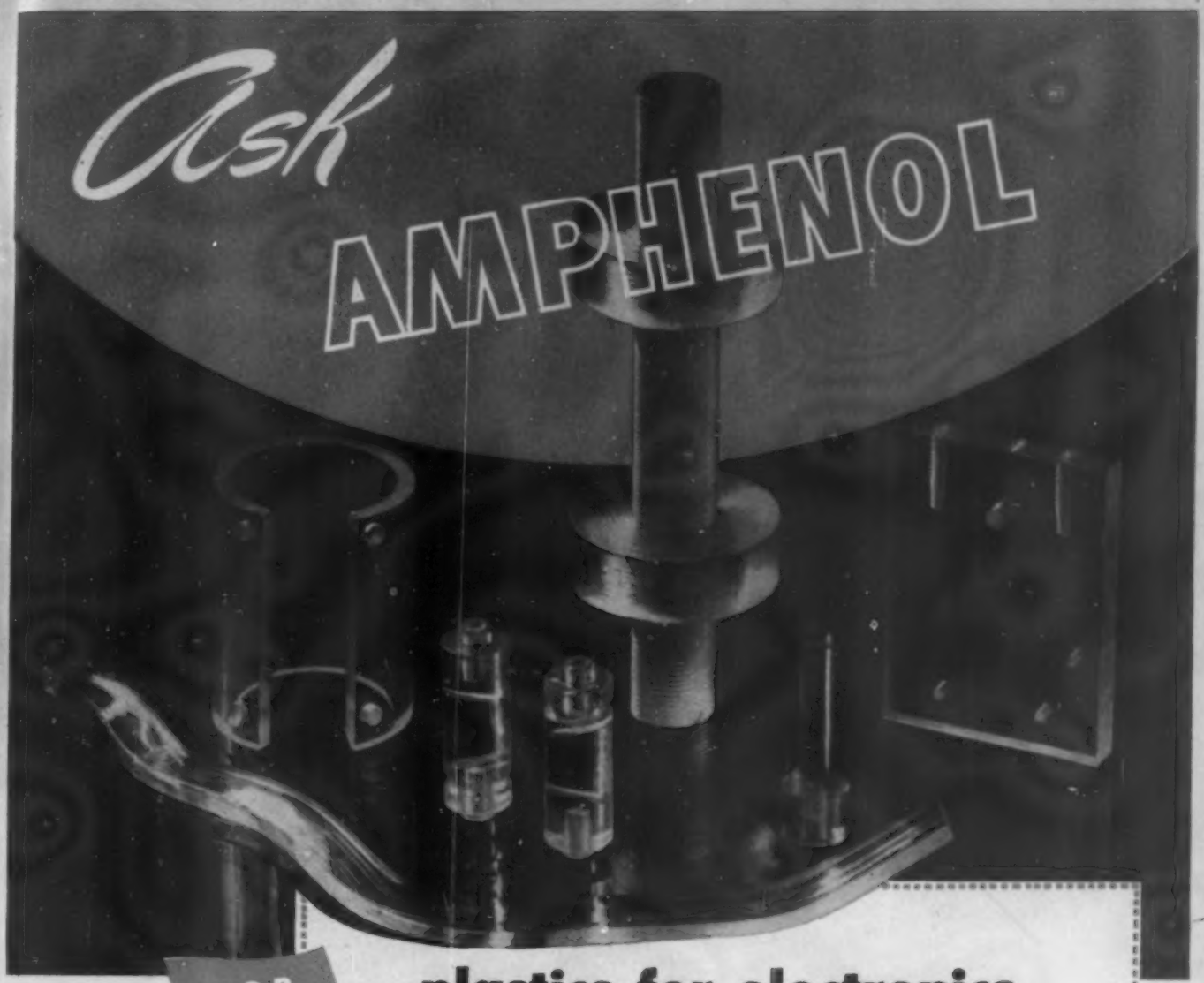
In clear and in colors, CORDO-FLEX presents a war-proved method of packaging for protection, preservation and identification. Please write for complete data, explaining any proposed applications, for specific recommendations.

other CORDO products

CORDO-BOND • Industrial Adhesives
CORDO-CLAD • Plastic Metal Coatings
CO-RES-CO • Maintenance Coating
CORDO CLOTH COATINGS • Plastic Surfacing for Textiles

CORDO-CHEMICAL CORPORATION
34 Smith Street
Norwalk, Connecticut

CORDO-FLEX



FOR **plastics for electronics**

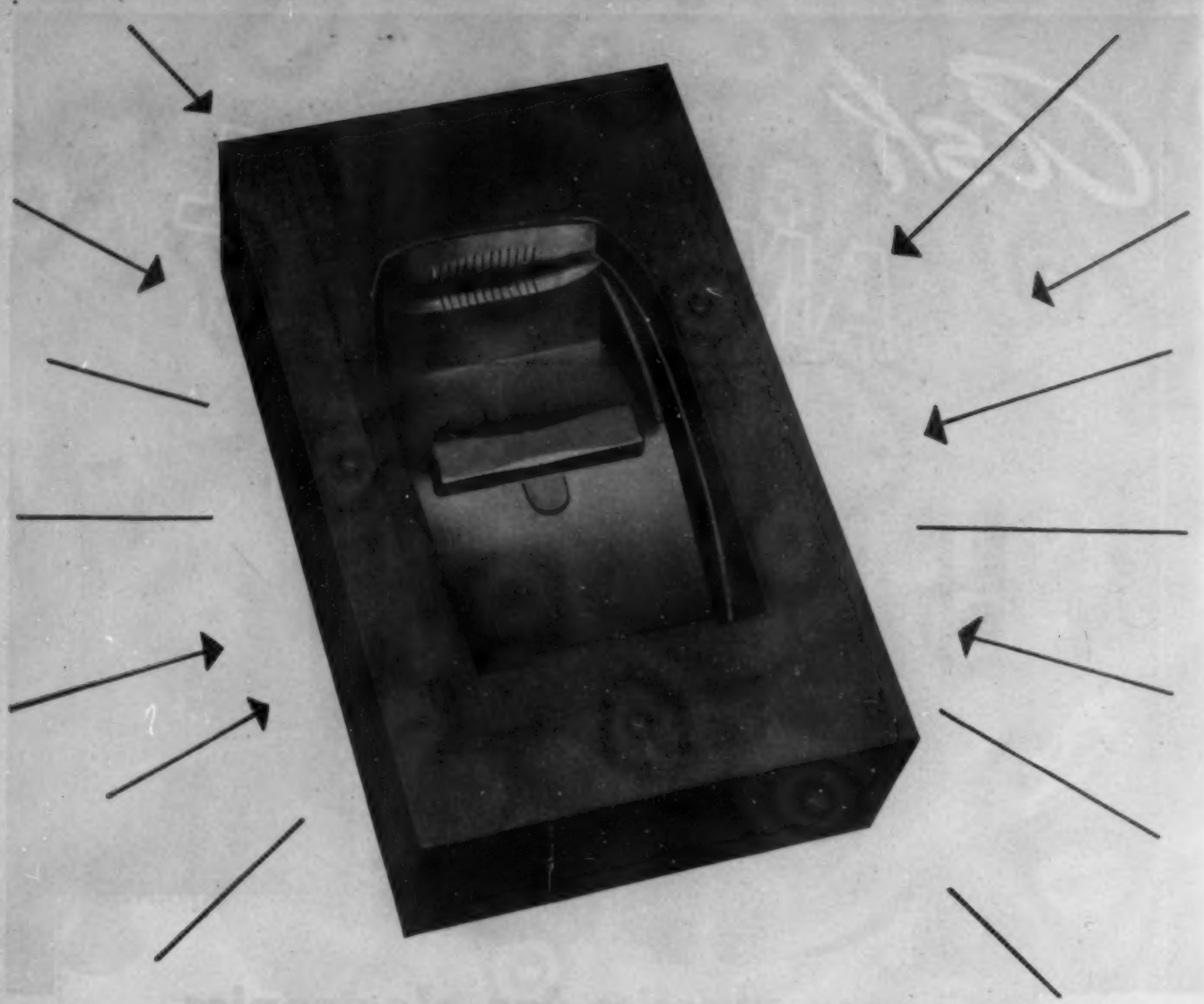
Electronics manufacturers operate under specifications that are extremely exacting in both electrical and physical characteristics. Close tolerances must be met in their equipment—therefore must be met in plastic parts Amphenol makes for them. Success in meeting these conditions usually boils down to *the right plastic* (with the required characteristics) *in the right form* (design).

Experience in this critical work enables Amphenol to serve a wide range of industrial manufacturers—particularly when the essentials are physical strength, elasticity, ability to stand wear or exposure to heat, moisture, oil, acid and other conditions.

Electronics and industrial manufacturers are finding the answers to such problems in Amphenol's engineering and production departments. Amphenol, one of the leading molders of plastics, has been well known in this field for many years and thoroughly proved by heavy wartime manufacturing schedules. As your problem's come up "Ask Amphenol."

AMERICAN PHENOLIC CORPORATION

Plastics for Electronics and Industry—Parts for Radio • R.F.I. Cable and Connectors • Conduit • Cable assemblies • Connectors (A-N, British, U.H.F.)



25 SQUARE INCHES OF PERFECTION

● Here is another difficult job—a hobbed cavity job—made easy by Midland. The block measures 9 in. by 12 in. by 6 in. The hobbed surface has an area of approximately 25 sq. in. It is 2 in. deep at its lowest point, and part of the surface is on an angle. Made for compression molding, this Hobbed Cavity by Midland is perfection in precision, finish and serviceability. Whatever your mold problem—regardless of apparent difficulties—bring it to Midland.

Two Valuable Booklets—Yours for the Asking!

"Shaping Tomorrow Today" tells about Midland facilities and methods. "How to Heat Treat Hobbed Cavities" gives detailed instructions for heat treating for maximum service.

Write for them today!

Hobbed Cavities by Midland

D&E

MIDLAND DIE AND ENGRAVING COMPANY

1800 W. Berenice Avenue • Chicago 13, Illinois

Cut Peacetime Fastening Costs

WITH THIS WARTIME SPEED METHOD!

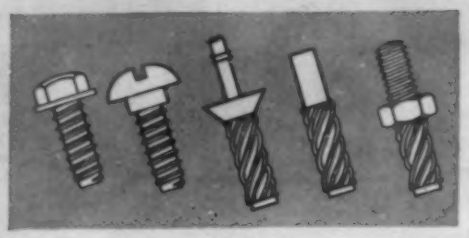
Holding production costs to a minimum is one of today's major reconversion problems . . . and just as P-K Self-tapping Screws proved the fastest and most economical way to make secure metal or plastic assemblies during wartime, they will help you keep peacetime production costs at a profitable level.

For a large percentage of fastening jobs P-K Self-tapping Screws offer a combination of ease, speed and security unmatched by any other fastening device or method. One easy operation makes a strong fastening with Self-tapping Screws . . . merely drive the Screws into plain, untapped holes. They eliminate the need for metal inserts – awkward riveting – and the fumbling that goes with handling bolts, nuts and lock-washers.

P-K SCREWS INCREASE EFFICIENCY OF BURGLAR-PROOF PADLOCK

This padlock represents some clever design work on the part of the E. T. Fraim Lock Company. The long drive screw on the left side goes into the brass cylinder sleeve, securely attaching it to the casing; the center drive screw goes into the hole in the sleeve for lock assembly purposes only; and the one on the far right side serves as a cover for the shackle stop pin. Nearly 3,000,000 specially designed P-K Screws have been used in the production of this padlock to date.

Sold Only Through Recognized Distributors



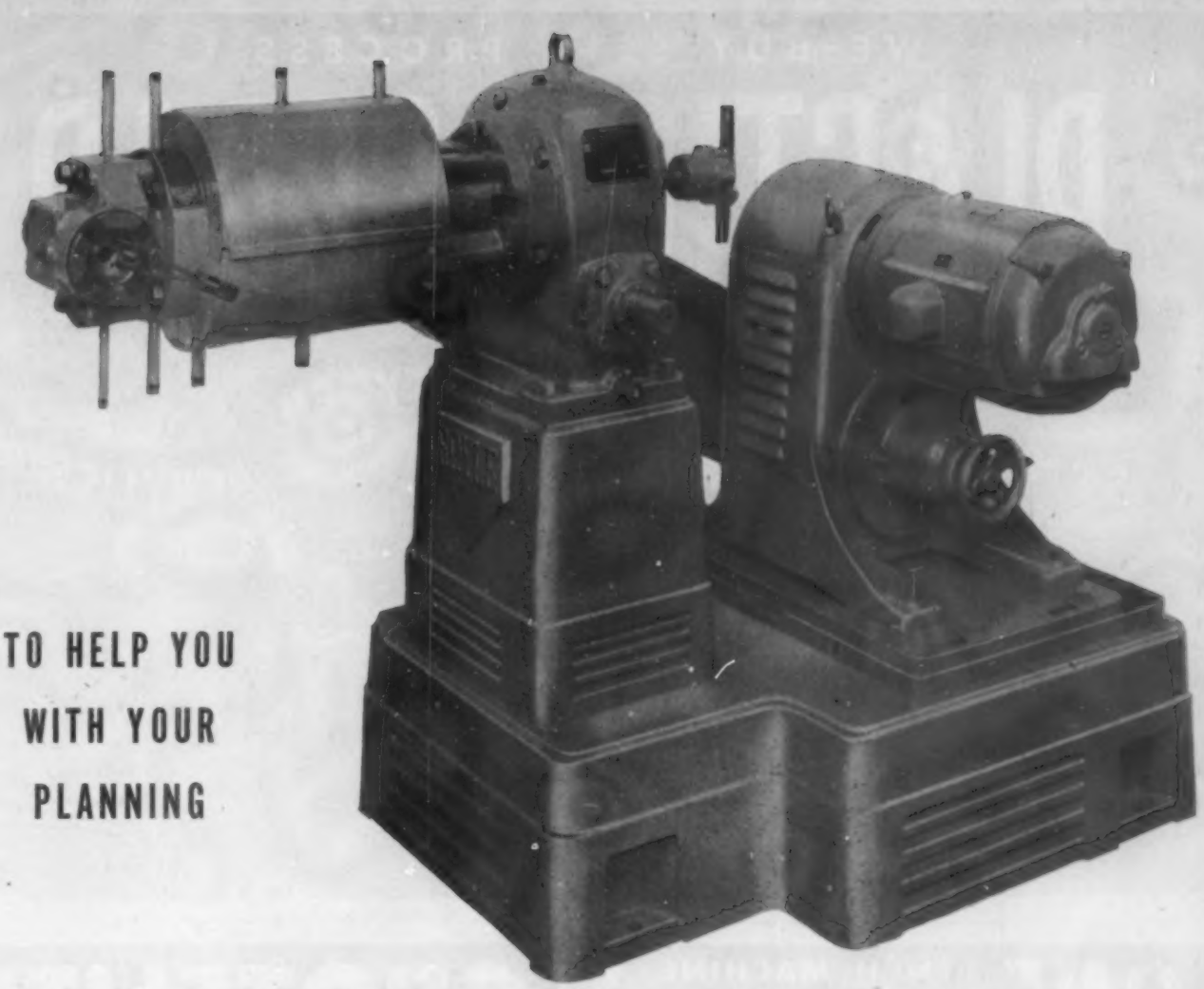
FUNCTIONAL, TOO! Parker-Kalon is equipped to produce P-K Self-tapping Screws in special forms so they may also be used *functionally* . . . as feet – as locking devices – as stops for springs – as retainers for bearings – as pivot pins – as shafts – as plugs for holes – and for scores of other special purposes.

A P-K ASSEMBLY ENGINEER WILL HELP YOU improve product quality, speed work and save money. He is a specialist in all types of plastic and metal fastenings and will be glad to visit your plant and work with you in searching out ALL opportunities for utilizing Self-tapping Screws. Or, you can mail assembly details direct to us for recommendations.

WRITE for P-K's free "Users' Guide". It is crammed with helpful information regarding where and how you can use P-K Self-tapping Screws most effectively. Address: Parker-Kalon Corporation, 208 Varick St., New York 14, New York.

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

For Every Metal and Plastic Assembly



TO HELP YOU WITH YOUR PLANNING

"THE LABORATORY GROUP" will tell you why the Royle #½ and the Royle #1 are the extruding machines you will want to know more about when you plan for the busy years ahead. Through evolutionary development features have been incorporated in these Royle extruding machines which will produce successful results with the growing number of extrudable compounds.

Whether you have plans for research or light product extruding "THE LABORATORY GROUP" can give you the basic information you will need. . . . If you plan to engage in research you will find that the Royle #½ and Royle #1 have the same characteristics as the larger Royle machines. . . . If you are going into light product extruding you will find it more efficient and profitable to extrude with a Royle designed for such a process.

Send for your copy of "THE LABORATORY GROUP" and let it suggest to you how Royle extruding machines can meet your requirements.

JOHN ROYLE & SONS

ROYLE PATERSON N. J. 1880

PIONEERED THE CONTINUOUS EXTRUSION PROCESS IN

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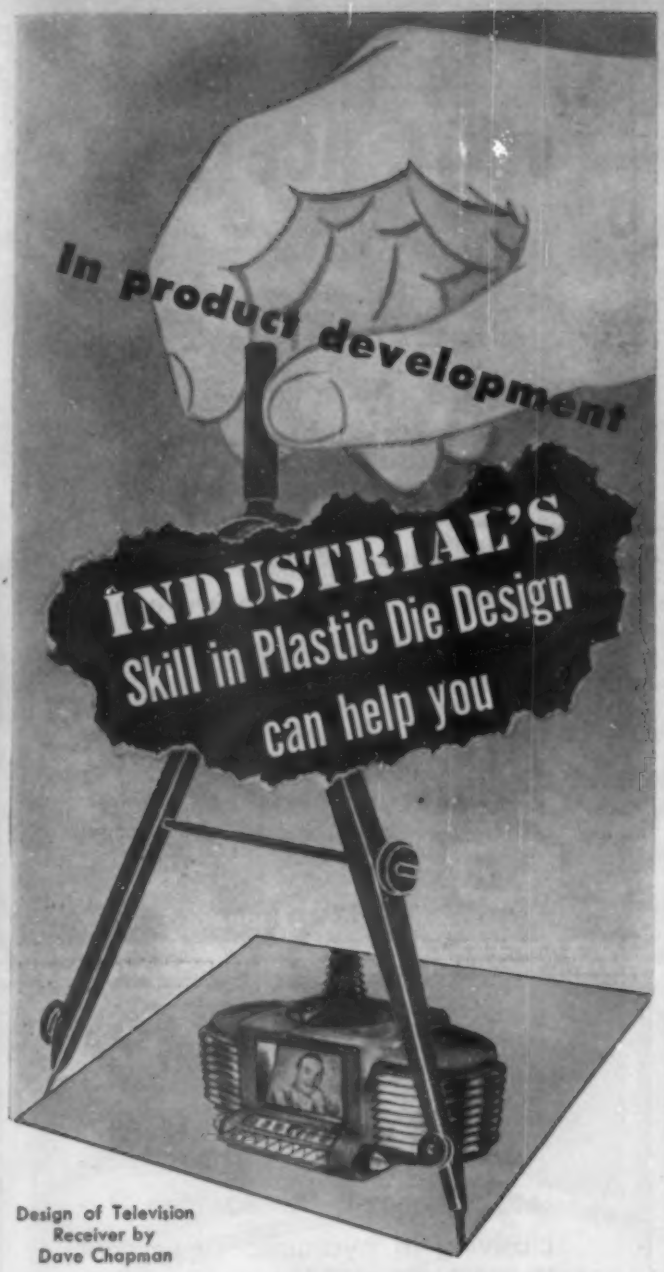


Design of Television Receiver by Dave Chapman

Plastic design problems can best be solved by consulting specialists in die-making and custom molding. Our staff of technical experts can give you experienced counsel on methods for production, single and multiple cavity molds, practical advantages of materials, their characteristics, and new applications in compression molding. Let us be of service to you. Write today.

South Bend Representative—
Mr. C. W. Krueger,
908 Tower Building. South Bend, Indiana.

INDUSTRIAL
MOLDED PRODUCTS CO.
2035 W. Charleston Street • Chicago 47, Illinois

Unit F with K handpiece. 1/8 H.P., 20,000 R. P. M. Other Models from 1/20 H.P. to 1/5 H.P. and up to 22,000 R. P. M. 8 Different speeds, rheostat controlled.

FLEXIBLE-SHAFT TOOL FOR MOLD-MAKING AND MAINTENANCE

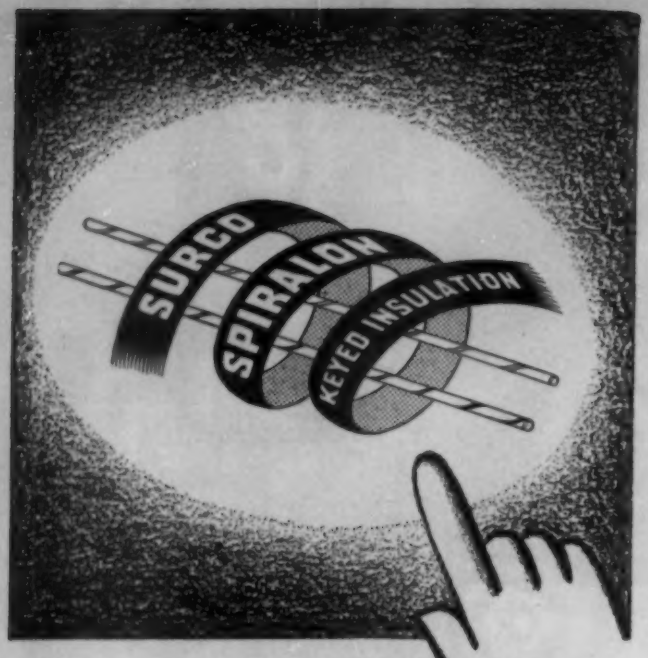
ARTCO flexible shaft tools are especially designed and constructed for making molds and maintaining them.

Two interchangeable handpieces, Type K with 3/32" and 1/18" collets—Type H with 3/32", 1/8", 3/16" & 1/4" collets enable user to work with more than 1,000 cutting, grinding, polishing tips.

Foot-operated rheostat allows all speeds between 5,000 R.P.M. and 20,000 R.P.M.

ARTCO is the *only* tool of its kind especially designed for use in the plastics industry. As such, it is used in hundreds of plants. Send for Complete Catalog without charge.

American Rotary Tools Company, Inc.
44 WHITEHALL STREET
BOwling Green 9-4895 NEW YORK 4, N. Y.



EASILY, QUICKLY IDENTIFIED!

Unlimited coding plus maximum insulation resistance

Spiralon, a new Surco plastic insulated wire, spiral striped, offers the widest range of tracer code identification in small as well as large sizes of wire, in short as well as long lengths. By avoiding use of color pigments, the primary covering retains full insulation resistance.

WITH NYLON JACKET

Spiralon reduces weight, permits a smaller OD., increases fungi and abrasion resistance, allows increased voltage, improves all electrical properties, eliminates all voids in the covering which ordinarily weaken such properties, resists creepage when terminals are being soldered or injury to wire insulation when accidentally touched by a hot soldering iron in production and overcomes deterioration from age. This high heat, low temperature non inflammable nylon jacket has already proved to be ideal for many applications.

A complete presentation on Spiralon is on the press. Please ask for your copy.

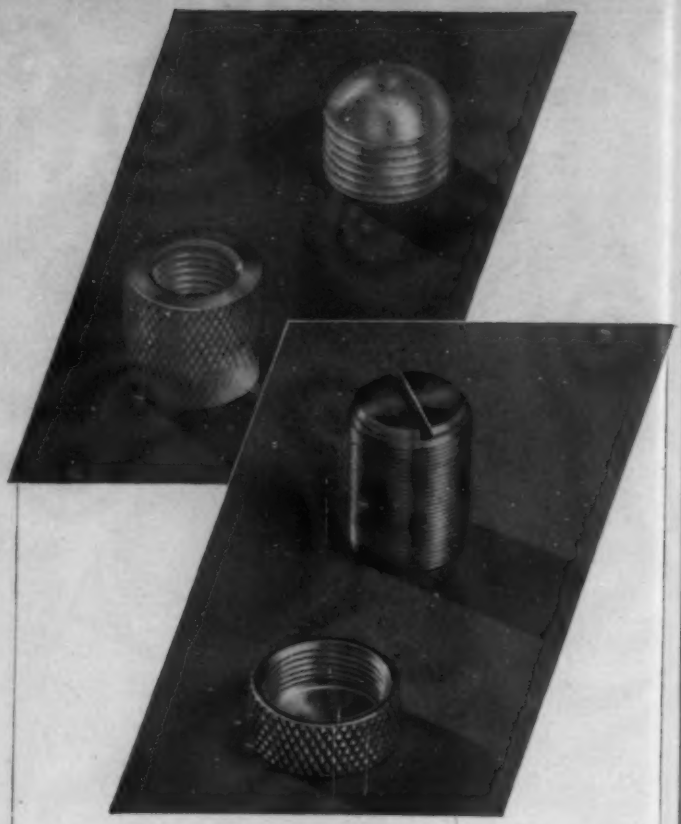
Address Dept. T

SURCO PRODUCTS

Surprenant

ELECTRICAL INSULATION CO.

84 Purchase St., Boston 10, Mass.



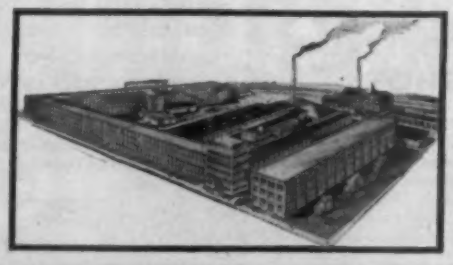
EITHER IS "O. K." AT HARTFORD

Inside threads . . . outside threads . . . knurls . . . in fact, any of the machining jobs you expect of HARTFORD in metal you may also expect of HARTFORD in plastic. The only difference in using either material are those imposed by the characteristics of the material itself. *Vast* precision secondary operation equipment for producing complete mechanical assemblies, component parts and sub-assemblies.

PLASTICS
From Rod & Tubing

Centerless Ground • Machined • Borizing • Slotted Milled • Knurled • Drilled • Threaded • Tapped

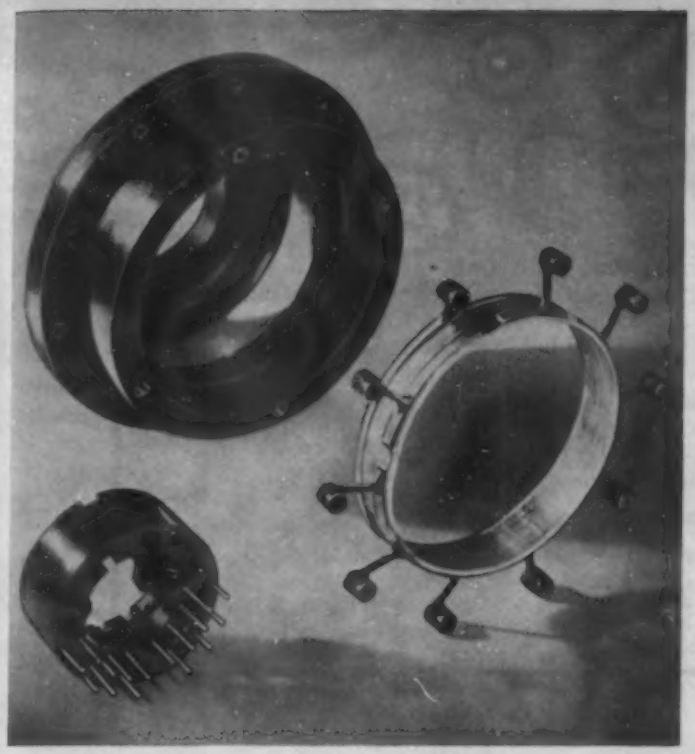
Metal Inserts



THE HARTFORD MACHINE SCREW COMPANY
Designer of Methods since 1876

SCREW MACHINE PRODUCTS
1/64" to 5" Dia. All Metals

HARTFORD, CONNECTICUT



INSERTS

These are two complicated moldings we make for precision instruments. Each is a problem in inserts. One is shown with the complex insert which is incorporated in the finished piece. Four other brass inserts are not shown separately. The other (smaller) part contains 20 delicate brass inserts.

Both of these pieces illustrate the mastery of compression molding of high-dielectric strength plastics with many inserts in perfect alignment which has made the name of Insulation synonymous with electric-resistant moldings for more than 50 years. Bring us your electric-plastic problems.

INSULATION MANUFACTURING CO.
CUSTOM MOLDERS OF PLASTICS FOR INDUSTRY
11 New York Avenue Brooklyn, N.Y.

Shiny as a Soldier's Shoes---
Slick as a Duck's Back!

THAT'S PHANEROL

Our chemist says: It's a blend of synthetic resins dissolved in a mixture of solvents to form a colorless, waterclear, transparent lacquer or laminating solution.

We both say: It's an invaluable water resistant finish in any shop or studio for coating, by spray or brush, labels, price tickets, posters—or what have you that you want laminated with a clear flexible film that dries quickly?

We think you'll say so too—When you have sent for a

FREE SAMPLE

Packed only in gallon jugs at $7.50 each f.o.b. Malden

Fine Chemicals Division

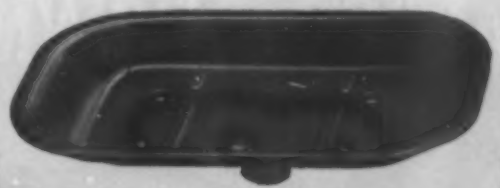
IVANO INCORPORATED

166-184 Commercial St. Malden 48, Mass.

A PLASTIC ANSWER

TO YOUR PROBLEM

The secret of success in plastics is in knowing the right plastic to use for the job at hand. Many items are practical to make in plastics for those who have the "know how." ● Your work at Magnetic Plastics is custom moulded from plastics best suited for the job. ● Ask us to help you see what plastics can do in your business. Just send photo, sample or specifications, and we'll tell you quickly if it can be made in moulded plastics.



THE MAGNETIC PLASTICS CO.
1900 EUCLID BLDG. • CLEVELAND 15, OHIO

Helping shape the things to come!

Here's a machine for cutting and trimming plastics. When you have to meet exacting requirements on a volume basis, consider the advantages of the Stanley-Carter Router.

Most types of plastic material can be cut or trimmed with Stanley-Carter Routers. Their high speed operation (18,000 R.P.M.) gives smoother finishes. Many types, sizes and shapes of cutting blades can be used too. Special threaded motor housing provides quick, accurate control of depth. Write for complete information. Stanley Electric Tools, Stanley-Carter Sales Dept., New Britain, Connecticut.

CARTER (STANLEY) TOOLS

TRANSPARENT PLASTIC DEMONSTRATION MODELS

Such models tell the *inside story* of your product. Invaluable for demonstration and study of moving mechanical parts.

COMPRESSION - INJECTION - TRANSFER MOLDS

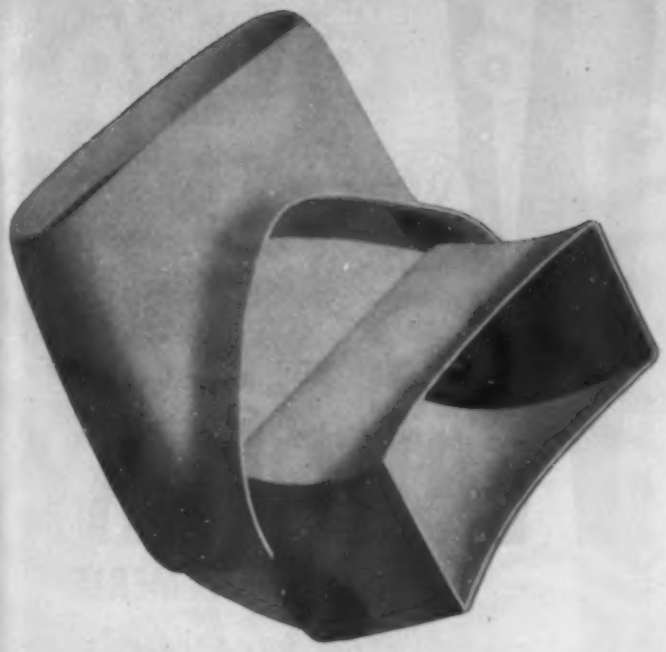
STRICKER BRUNDIDGE CO.
Mechanical Developers
19 WEST 24th ST. (SB) NEW YORK 10, N. Y.
WAtkins 9-0191

Taylor Instrument Cos. RETURN TO *Plastic Turning Co.* FOR PEACE-TIME FABRICATION OF BAROGUIDE'S CATALIN BASE AND CASE

Emerging from its heavy loads of war production, the Taylor Instrument Companies, Rochester, New York, immediately entrusted to us again, the fabrication of the famous Baroguide case and base in rich, sparkling Catalin.

Attractive in every detail, this fabrication demonstrates the splendid results obtainable with our engineering skill, and experience in cast phenolics. Just as we cooperate with Taylor Instrument Companies in the mounting for the Baroguide, so would we welcome the opportunity to introduce you to the many appealing features of plastics fabrication.

PLASTIC *Turning Co. Inc.*
LEOMINSTER, MASS.



TAKE THIS SHAPE . . . or Any Other

It presents no problem when the Winner Process of low pressure laminating is employed. This method, developed by Winner engineers for wartime production of aircraft and marine parts is now available for other products with these advantages:

1.—Great strength combined with light weight.
2.—Low tooling cost enabling short runs.
3.—High resiliency and tensile strength.
4.—Dimensional stability.
5.—Vibration proof . . . dielectric . . . withstands elements . . . resists corrosion.

In addition to our work with fluid pressure, we are also making pieces using various types of contact resins. We invite your inquiries regarding products of any shape or size.

WINNER PLASTICS

DIVISION OF WINNER MFG. CO., INC.
200 Railroad Ave. West Trenton, N. J.

AN EXCITING COMBINATION:

PLASTICS & DECALS!

The combination of transparent laminates or sheets protecting colorful designs, decorations, trade-marks and other illustrations applied in the form of decals makes an exciting contribution to the field of decorative plastics. We supply the decals in all colors—as many as you like—to your design; or we'll make a design to suit your purpose. Decals so easily applied by unskilled labor in your own plant are widely used to decorate and identify the surfaces of molded, extruded and fabricated plastics, too. Send for information, samples, prices.

PALM, FECHTELER & CO.
220 W. 42nd St., New York 18, N. Y.
21 E. Van Buren St., Chicago 5, Ill.

All classified advertising payable in advance of publication. Minimum, $5.00 (up to 60 words); in border, $10.00 per inch.

Classified Advertisements

For further information address Classified Advertising Dept. MODERN PLASTICS 122 East 42nd St., New York 17, N. Y.

EXPERIENCED MOLD MAKER

Wanted by an old substantial Southern New England Company having a very modern toolroom. Write for interview, giving details as to experience. Replies will be confidential. Box 1330, Modern Plastics.

FOR SALE—1—French Oil Hypdropneumatic Accumulator; 1 Worthington Hyd. Pump 1 x 6, 5 GPM 6000 pressure M.D. 1—14" x 24" Press, 9" ram; 4—24" x 55" steel cord Heating Platens; 4—W. & P. Mixers; 1—Thropp 10 x 24" Rubber Mill, 1—8 x 13" Rubber Mill; 1—set of 18 x 50" Compounding rolls, reduction gear and motor; 1—Stokes Rotary 32 punch Preform Press; 6—Hydraulic Presses, 20 x 20", 12 x 14"; Allen 6" Tuber; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 1310, Modern Plastics.

WANTED: Assistant in Plastics Research Lab in Paper Mill. Should also have experience in Latex saturation. Give age, references, experience and salary expected in first letter. Our plastic staff has been notified of this advertisement. Reply Box 1342, Modern Plastics.

SPENCE-RIGOLO

PRODUCT DESIGN & STYLING

677 Fifth Ave., New York 22, N. Y.

WANTED: Small or medium sized plastic molding plant with either hydraulic extrusion or injection equipment with or without tool shop. Advise full details. Reply Box 788, Modern Plastics.

INDUSTRIAL DESIGNER wanted. Must be topnotch. Rendering, styling, successful product experience important, plus ability to meet clients and handle accounts. Excellent permanent future, high salary. Write or visit our office nearest you. J. GORDON LIPPINCOTT & CO., 500 Fifth Avenue, New York City. 230 North Michigan Avenue, Chicago.

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin material. Submit samples and details of quantities, grades and color for our quotations. Reply Box 508, Modern Plastics.

Long established reputable concern with substantial capital will buy for cash, Assets, Capital Stock, Family Holdings of industrial plants, mfg. divisions, units. Among other considerations, you may realize certain desirable tax advantages. We are principals and act only in strictest confidence, retaining personnel wherever possible. Address Box 1230, 1474 Broadway, New York 18, N. Y.

Do you need a Hydraulic Press for Compression Molding, Transfer Molding, Laminating, Forming, Bending and Hobbing? Whatever it may be, if it is hydraulic, see Sal-Press Company, 388 Warren Street, Brooklyn, N. Y. Specializing in rebuilding of new, and used hydraulic equipment.

WANTED: Molding room foreman—Experience in multicavity compression molding-setup-mold repairs—molding technique-polishing. Midwest location. Excellent opportunity right man. Write stating age, experience and salary expected. Reply Box 1352 Modern Plastics.

FOR SALE: 1—500 ton Hydraulic Press with downward moving ram and pushbacks. Box 512, Modern Plastics.

Puerto Rico—Representation. Aggressive men with established industrial contact, now representing other lines, wishes to represent reliable plastics firms in this Island. Rafael Nevares, C. E. Santurce, Puerto Rico.

WANTED: PLASTIC SCRAP OR REJECTS in any form. Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

PLASTICS ENGINEER wanted to head a Plastics Laboratory for the investigation and application of plastics to precision mechanical and electrical devices. Man should be a graduate engineer thoroughly familiar with the physical characteristic of molding compounds and the proper design practice for their use. Reply Box 1326, Modern Plastics.

IN THE MARKET FOR: Stainless Steel or Nickel Kettles, Vacuum Pan, Preform Machine and Mixer, Hydraulic Presses. Reply Box 825, Modern Plastics.

"Safety Engineer" offers services to maintain a low accident frequency, and is capable of training personnel to take a sincere interest in safety. Reply Box 1351, Modern Plastics.

FOR SALE—1 Farquhar 100-ton Extrusion Press with 7½ H.P. Pump Unit, 3 phase, 220 volt, 60 cycle. Material cylinder 10" diam. by 38½" long. Stroke 40". Material cylinder hydraulically tilted to facilitate loading. Electric interlocks for safety. Floor space 111" x 42". Slightly used.
Pass & Seymour, Inc.
450 Boyd Avenue
Syracuse 9, N. Y.

Unusual opportunity for experienced Production Man for Cellophane Converting Co. in Middle West.—Cellophane Printing and Bag making Experience necessary. Reply Box 1353, Modern Plastics.

Available November 1st; Veteran, owned own moulding plant prior to war, last position General Manager compression plant. Handle compression, injection and transfer moulding, some sales contacts. Spent last fourteen months at Plastics Institute, Los Angeles, applying theory to practical experience. Locate New England, Mid Atlantic States or Foreign. Reply Box 1354, Modern Plastics.

Position wanted—Graduate chemist, 34 yrs. old, married, 5 yrs. experience in research, development, design and production in phenolics and replacements, lignin and wood plastics, furane resins, cold molding and thermoplastics. Established, equipped and directed plastics laboratory for past 4 yrs. Prefer location in New England with organization desiring new ideas and results. Reply Box 1355, Modern Plastics.

ADDITIONAL PLASTICS AND DIE CAST LINES WANTED

A Cleveland, Ohio, Company, with good office location, would like to represent additional lines as sales engineers.
Desire lines such as: Plant Equipment, Adhesives, Inserts, Tools and Special Compounds for plastic and die casting.
At present they are contacting molding plants, tool shops and users of plastic and die cast parts. Reply Box 1356, Modern Plastics.

FRENCH REPRESENTATION—Electrical Engineer, recently demobilized, offers representation in France for insulating materials used in electrical and radio construction. References on request. Reply Box 1357, Modern Plastics.

For sale One DeMattia Injection Molding Machine 2 ounce, delivery in November. Reply Box 1358, Modern Plastics.

FABRICATORS: A newly formed sales organization comprised of technically trained men with many years of experience in plastics wants representation in the Middle Atlantic area with manufacturers of plastic products. Address: P. O. Box 1774, Charleston 26, West Virginia.

FOR SALE:—Hydraulic Presses, 600 ton Watson Stillman double acting downward ram, platen 24" x 24", 1—36" x 36", 12" ram 200 ton, all steel construction, 2—20" x 20" 10" rams, 1—24" x 24" 6" ram, 75 ton capacity, 1—52" x 26" 14" ram, 400 ton capacity, 2—15" x 15" 8½" rams, 2—12" x 12" 7½" rams, 1—26" x 45" 10" ram, 100 tons capacity, 14 x 14" 5" ram, 30 tons capacity, 20" x 20" 8" double acting upward ram, 20" x 20" 13" ram, 20" x 40" 2—8" rams, 2 post 20" x 24" 16" ram, 400 ton capacity, 2—20" x 18" 200 tons with pushbacks, 2—36" x 24" 250 tons with pushbacks, 1—24" x 24" 200 ton with pullbacks; Pumps: Robertson Triplex 5 GPM 5000 lbs., HPM Triplex 1½ GPM 2500 lbs., 4 plunger vertical 4 GPM 2250 lbs., National Triplex 3 GPM 4000 lbs., Hele Shaw JLP 12, 44 GPM 1200 lbs., HPM 1¼ GPM 2000 lbs. on high, 16 GPM 400 lbs. on low, V Belt Drive; Accumulator; Hydro-Pneumatic 4½" dia. plunger 27" stroke, 18" dia. cylinder with By-Pass Valve, Extruder, 6" Housatonic, for camelback, 1—No. 1 Royle Perfected; Mills, Calenders, Mixers, etc. HIGHEST PRICES PAID FOR YOUR USED EQUIPMENT.
Universal Hydraulic Machinery Company,
285 Hudson Street, New York City 13.

NEW LINES WANTED

Modern Sales and Service organization in Philadelphia having unusual Industrial clientele now specializing in Paint Spray Equipment, Air Compressors, and kindred items desires to increase their lines of merchandise. Hovey Spray Equipment Co., 1511-13 Spring Garden St., Phila., Pa.

Collection Service.

We have been collecting bad debts for thousands of concerns since 1914. Can we assist you in clearing them up? We go everywhere. Member of Commercial Law League of America. Protective Claim Assn. Inc., 1776 Broadway, N. Y. C.

Plastic Engineer with seven (7) years' experience in the industry desires position as development engineer, Manager in the molding industry, or Consultant to an industry using plastics. Reply Box 1360, Modern Plastics.

Wanted—Experienced treater machine operators. We desire men with experience in operating coater machines for laminates. Write full details of experience, education, and wages desired. Reply to T. H. Vaughan, P. O. Box 301, Hampton, South Carolina.

WE BUY AND SELL All types of Plastic Scrap and Plastic Molding Materials. Inquiries invited. Plastic Waste Materials Co., 14710 Milverton Rd., Cleveland 20, Ohio.

Mold Designer, with practical experience, designing compression, transfer and injection molds and to take charge of mold procurement. Full details, experience, education, and salary desired. Large Rubber Products Manufacturer—Location East. Reply Box 1361 Modern Plastics.

Position Wanted—Foreman of mixing, milling, calendering unsupported Vinyl Film. Reply Box 1362, Modern Plastics.

Manufacturers of Packaging and Plastic Products Are you seeking aggressive representation in Metropolitan New York area? Our customers are volume buyers in cosmetics, toilet goods and allied industries. Write Box 1363, Modern Plastics.

WASHINGTON, D. C., RESIDENT REPRESENTATIVE

Business man with Government agency staff experience, available to substantial firm as Washington representative in selling to the Government; in negotiations with Washington offices of Government agencies; or surplus property purchases. References. Reply Box 1367, Modern Plastics.

What Would be Your Hand-Finishing Time on a Job Like This?

Close-up view of the six-cavity solid mold block.

Plastic hat-and-coat hook as produced by six-cavity mold.

60 hours! That was the total milling time for completing both halves of this mold for plastic coat-and-hat hooks . . . with speed and precision, on a Milwaukee Rotary Head Milling Machine.

The outline of one cavity was scribed on the block by means of a scriber, held in the machine spindle. Each operation was performed first on the layout position . . . and then repeated for each additional cavity, by simply moving the machine table the correct center-distance between cavities. The precisely controlled movements of the machine made it possible to mill this mold quickly and accurately . . . to a good finish that required a minimum of hand work.

In the main illustration above, the Milwaukee Universal Extension Attachment is shown, milling a 7" radius on the mold.

Write for Bulletin 1002C for complete information on this unusual Milwaukee Rotary Head Milling Machine and the rotary head method of milling. Address Department 1A.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC JIG BORER • CENTER SCOPE.

Kearney & Trecker
Products
CORPORATION
MILWAUKEE 14, WISCONSIN
Subsidiary of Kearney & Trecker Corporation

EXECUTIVE to be in charge of sales, development, design engineering for plastics fabricating and laminating company. Excellent opportunity for right man. Box 1364, Modern Plastics.

Top flight engineer, Excellent record on highest precision extruded sections. Interested in organizing proprietary extrusion for East Coast firm. Box 1375, Modern Plastics.

Wanted: Manufacturers' representatives throughout the United States who are in a position to secure orders for plastics items that can be produced on compression and transfer presses; commission basis. Reply Box 1366, Modern Plastics.

PLASTICS ENGINEERS
Chemical or Mechanical degrees, with experience in product design, mold design, development and production of plastics. Prefer individuals with training in low pressure laminates. Kindly give experience, education, Replies are confidential.
YORK RESEARCH CORPORATION
63 Park Row, New York 7, N. Y.

POSITION WANTED: Graduate mechanical engineer—with 5½ years experience, three of them as assistant to supervisor, in designing compression and transfer molds for intricate high dielectric parts fabricated from thermosetting plastics and inserts—desires a position as engineer with prospective future with a progressive molding company in the east. Age 31, married. Reply Box 1369, Modern Plastics.

WANTED; ASSISTANT SUPERINTENDENT. Southern Connecticut Company. Familiar with transfer and injection molding and capable of estimating intricate plastic molds. Reply stating age, experience, salary requirements, etc. Box 1365, Reply Modern Plastics.

FOR SALE: Farrel Birm., 150 ton Mold Presses; also 25 to 250 tons; 36" x 36", 20" x 40", 16" x 16", 12" x 12", 30" x 36", 24" x 28", 40 ton Broaching Press; 400 ton Extrus. Pr.; W. S. Hor. 4 plgr. 1" & 2" x 4", H & L pressure pump; W. S. 1½" x 12" hr. 4 plgr. 30 GPM. 3500 lbs. H.P.M. 1½" x 6", vert. Triplex, 10 GPM, 2700 lbs.; 2-Oilgear Pumps, 13 GPM 1250 lbs.; Wat.-Farrel 1½" x 4", vert. triplex, 6 GPM, 3000 lbs., Goulds 2¼" x 8" vert. triplex 30 GPM, 1600 lbs.; Elmes 1" x 4" & 1½ x 4" hor. 4 plgr., 5 to 8 GPM, 4500 lbs. & 5500 lbs. Rumsey 4½" x 8" vert. triplex, 65 GPM, 900 lbs.; Elmes 2½" x 4" hor. 2 plgr., 17 GPM, 850 lbs.; 10 HP hor.s. 1½" x 4" triplex 6 GPM, 3000 lbs.; New Vickers Oil Pumps, 22 GPM, 1000 lbs.; New Vickers 1¼" Oil Relief Valves; New Vickers ¾" Flow Control Valves; No. 2 Extruder; Hy. Steam Pumps; Hand Pumps; Low Pressure Pumps 150 to 600 lbs.; Hydr. Accum., Heavy Duty Mixers; Roller Conveyor, Grinders, Pulverizers, Gas Boilers, etc. . . . . PARTIAL LISTING. We BUY YOUR USED MACHINERY. STEIN EQUIPMENT CO., 426 BROOME ST., NEW YORK 13, N. Y. CANAL 6-8147.

Soon Available
Plastics Engineer
Factory Superintendent
Naval Officer—with 16 years experience in Compression and Transfer molding, Available after October 1st. Comprehensive knowledge in factory management, incl. estimating, molding and finishing operations, assembly tools, cost reduction, inspection, testing, plant layout; labor relations and development. Graduate Chemical Engineer, Desires managerial position. Reply Box 1374, Modern Plastics.

TOP NOTCH INDUSTRIAL DESIGNER

now with large molding corporation desires change. Record of developing highly successful merchandise and many patents. 20 years design experience. Independently produced large volume molding business and increased profits. Accustomed to meeting public. Salaried position or fee accounts solicited. Reply Box 1368, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER with resin background desired by Eastern Company. Must have production or laboratory experience in phenolic or urea molding compounds. Bachelor or higher degree. Excellent opportunity. State qualifications including age, training, experience, salary desired, and include recent snapshot. Reply Box 1371, Modern Plastics.

PLASTICS ENGINEER: With knowledge of Fabrication, Molding, and Laminating. Mold design experience essential. For salaried position in leading Plastics School. Write qualifications and send photo to BOSTON TECHNICAL INSTITUTE, School of Plastics, 4707 Euclid Avenue, Cleveland 3, Ohio.

FOR SALE
1—Rodgers 2 plunger Oil Pump 2 GPM 3000#; 1—Logan Oil Pump 5 GPM 750#; 3—Vickers Oil Pumps 17 GPM 500 to 1000#; 1—Metalwood Horizontal 4 plunger 1 GPM 3000#; 1—Rumsey Vertical Triplex 300 cubic inches 3000#; 2—Deane Worthington Triplex Pumps 400 cubic inches 4000#; 1—Gould Vertical Triplex 24 GPM 2500#; 1—Robertson Vertical Triplex Pump 7 GPM 5000#; 1—Robertson Vertical Triplex Pump 4 GPM 6500#; 2—Gould Vertical Triplex Pumps 200 GPM 500#; 1—Elmes Horizontal 4 plunger 6½ gallons 5000#; 1—Watson Stillman Horizontal 4 plunger 11 GPM 5000#; 2—Galland Henning Horizontal 4 plunger Pumps 50 GPM 2000#; 2—42 x 42" 14" ram presses; 2—80 ton Elmes 17 x 17" downward-moving ram presses; 1—Elmes 50 ton 18 x 18" downward-moving ram press; 2—30 ton Watson Stillman 12 x 12" Laboratory Presses. Reply Box 1225, Modern Plastics.

WANTED
SELL, RENT or LEASE stock dies for injection moulding machines to large Canadian Company. 15 salesmen calling on drug stores, chain, variety, and department stores, also jobbers. Warehouses and sample rooms in Toronto, Montreal, Saint John, N.B., Winnipeg and Vancouver. Reply Box 1373, Modern Plastics.

SWEDEN
WANTS PLASTICS!

The leading Swedish sales organization in the plastics trade wishes to complete its program of phenolic and urea resins with sole agencies for other kinds of plastics, especially thermoplastic materials, melamine resins and lacquers, available for export from the U.S.

Please send your offer to—

Mr. Erik Killander
Kungsgatan 48
Stockholm, Sweden

MANUFACTURERS!

Don't delay production of your post-war products. We are ready to contract for volume production runs and assume the risk of selling and merchandising your product.

Our organization is operating now on a worldwide scale with a large sales force of our own. We are over 10 years old, well rated, have more than a million dollar annual volume with a trade name extensively advertised in consumer magazines, newspapers and trade publications.

If you have or plan to make household items, kitchenware or similar products for distribution in the department, chain, drug or hardware fields, we are ready to sit down with you and talk facts that will get your factory rolling quickly. We have no desire to control or buy firms but have a very successful record of extending practical design and engineering advice, helping with financing where necessary and building up a profitable working arrangement that has stood the test of time with others.

Write Box D 1350, Modern Plastics.

INDEX TO ADVERTISEMENTS

MODERN PLASTICS*
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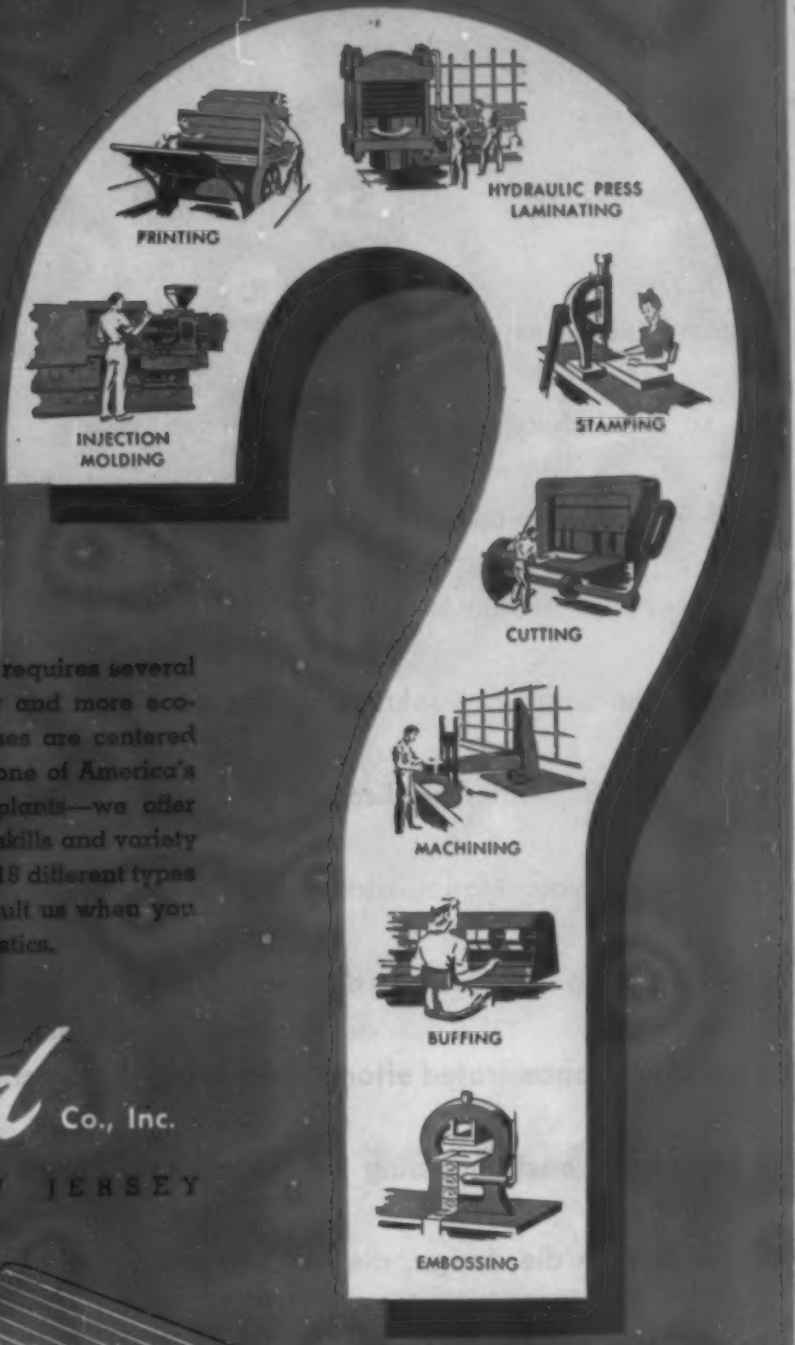
MODERN PLASTICS
Published by MODERN PLASTICS, INC.
122 EAST 42nd ST., NEW YORK 17, N. Y.

Need a Complete plastic service



Plastic products whose manufacture requires several operations can be turned out faster and more economically when all production phases are centered at one source. Here at Emeloid—in one of America's most completely equipped plastic plants—we offer that kind of service . . . a diversity of skills and variety of facilities which include more than 18 different types of operations. We invite you to consult us when you need "combined operations" in plastics.

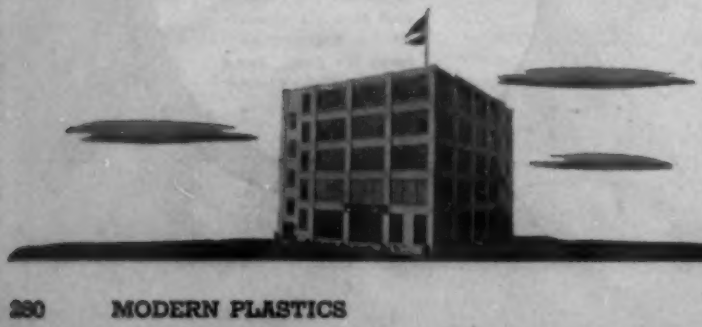
The Emeloid Co., Inc.

ARLINGTON • NEW JERSEY

This illustrated brochure, "Progress in Plastics", commemorating the 25th anniversary of the founding of Emeloid, tells the dramatic story of Emeloid's growth and how its diversified services can perform for you. Send for your free copy . . . today!

Fulfilled to the Letter

Custom injection moulding, so successfully applied to our war-time volume production, may well be the source of solution to the very problem of a plastics application you now have before you. Nation-wide concerns in ever increasing numbers, are discovering the value of our concentrated efforts which bring to bear upon each moulding the full range of our skills in die design, die making, production and finishing, plus all of our other extensive facilities. Our customers have learned to count on volume, precision and low unit cost even when specifications involve such varied qualities as metal inserts, deep external and internal threading, water-tightness, thin or heavy sections and numberless design effects. By maintaining a fine balance between the creation and the practical use of a moulding, our efforts have turned customers' problems into profitable plastics applications. Perhaps we can treat yours the same way.

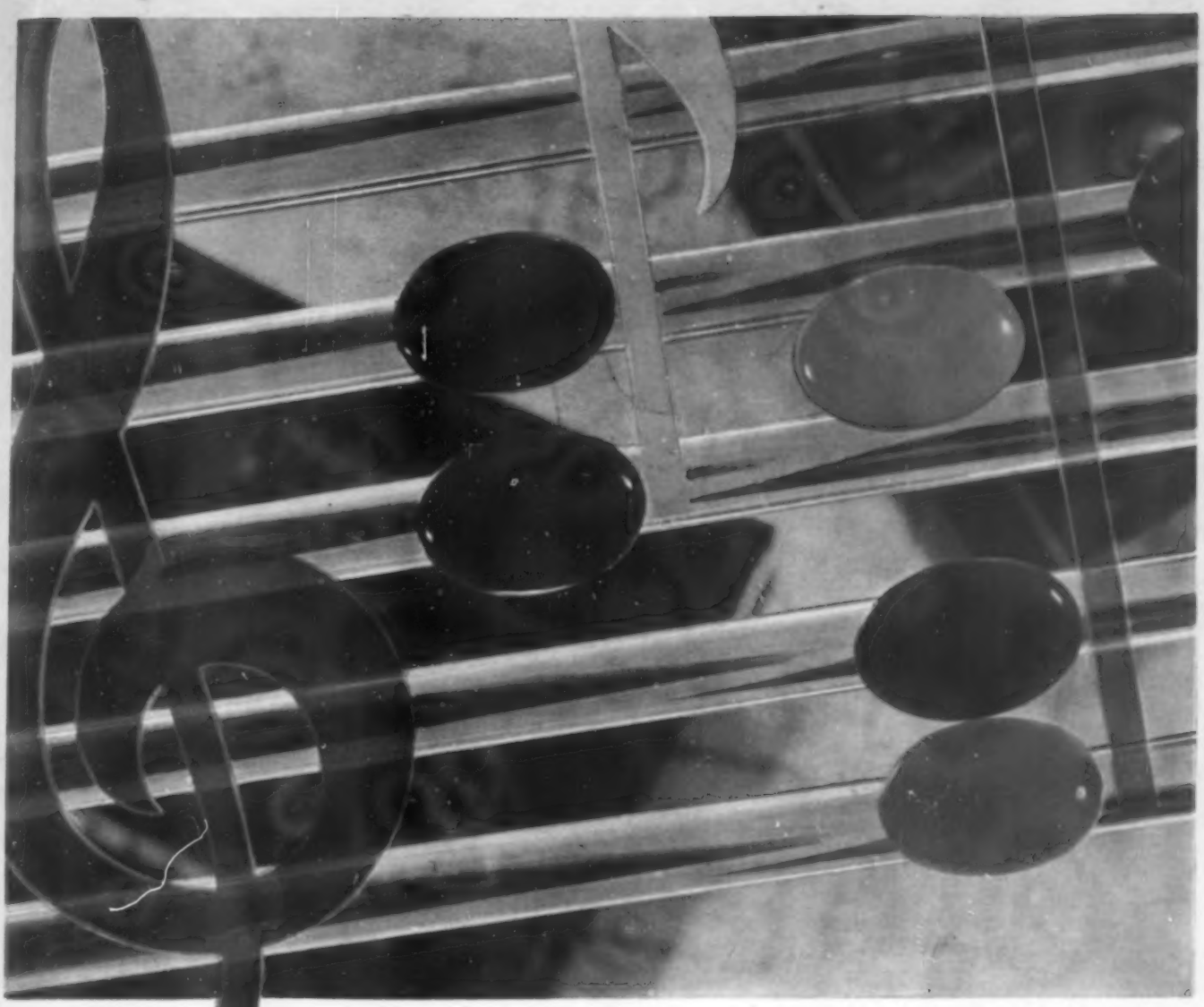


Custom Injection Moulding

WORCESTER MOULDED PLASTICS CO.

14 HYGEIA STREET, WORCESTER 8, MASS.

17 East 42nd St., New York 17, N. Y.
Export Office: 90 Broad St., New York 4, N. Y.



THE *Swing's* TO COLOR!

Amethyst, garnet, emerald, turquoise — BAKELITE cast resins present a wonderland of brilliant color for the gay, eye-appealing products of tomorrow. For radio cabinets, clock cases, cutlery handles, kitchenware, wherever color can enhance sales appeal, the swing will be to the gem-like radiance of these unique plastics, and their distinctive mottled and striated effects.

BAKELITE cast resins are formed and fabricated by economical processes. First, a master steel arbor is made to the desired specifications. Then molds for casting are formed by dipping the arbor into molten lead so that a lead shell "freezes" on its surface. This shell, or mold, is removed, subsequently filled with casting resin, and oven-baked, during which the resin hardens. Knocked from the lead shell, the solid casting is ready for final machining and polishing.

Bakelite Corporation also provides cast resins in standard sheets, tubes, and rods for the economical fabrication of a wide variety of products. Investigate BAKELITE cast resins now, and find out how you can benefit by their superior forming properties, brilliant appearance, and the production economies they make possible. Write Department 25 for Booklet B-1, "BAKELITE Cast Resins."

TRADE MARK

BAKELITE CORPORATION

Unit of
Union Carbide and Carbon Corporation

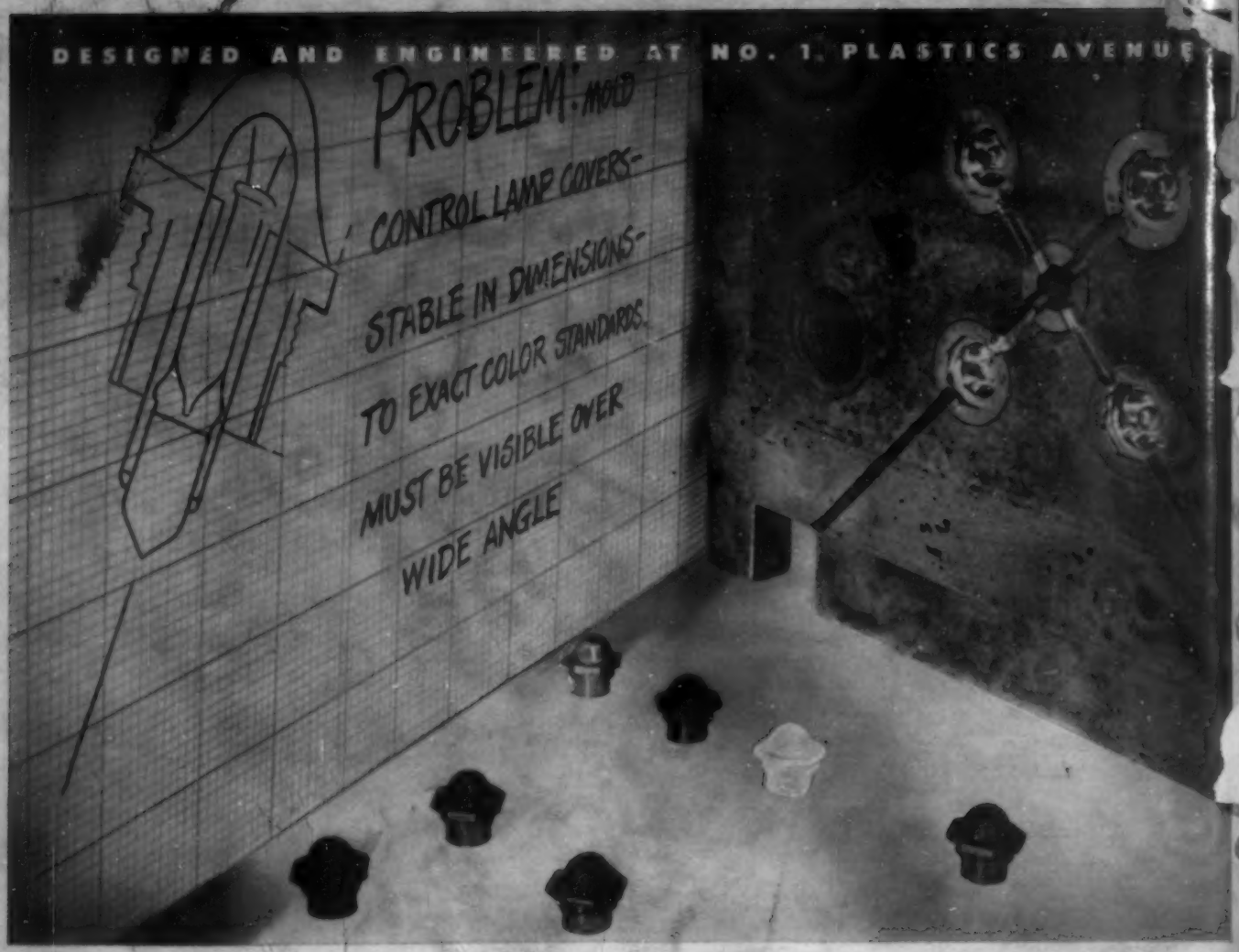
UCC

30 EAST 42ND ST., NEW YORK 17, N. Y.

BAKELITE

TRADE-MARK

CAST RESINS



PLASTICS WITH A GLEAM IN THEIR EYE

• Helping to keep the heaviest rail traffic in history flowing smoothly, these plastic indicator lamp covers gleam on switchboards in railroad signal towers across the country.

The same plastic signals flash their warnings on other control boards . . . in submarines deep beneath the Pacific . . . on vital electronic equipment in industry.

Available in colors of the Standard Railroad Color Code, these jewel-like translucent plastic products are designed and injection-molded at No. 1 Plastics Avenue.

Tremendous trifles like these receive full engineering and design attention from G. E.'s *complete* plastics service. Bring your plastics problem—no matter how large or small—to General Electric—the world's largest manufacturer of finished plastics parts. Write Plastics Divisions, General Electric Company, 1 Plastics Avenue, Pittsfield, Mass.

G-E Complete Service—Everything in Plastics

Backed by 51 years of experience. General Electric has been designing and manufacturing plastic products ever since 1894.

G-E Design and Engineering Service. Our own industrial designers and engineers work together. Result: plastics parts that are both scientifically sound and good-looking.

G-E Mold Service. Fully equipped toolrooms are manned by skilled craftsmen whose average precision mold experience is 12 years. G-E molds are chromium plated for longer life.

G-E Quality Control. Our plastic products may pass through as many as 160 inspections and analyses. Army-Navy rejections are so low as to be negligible at General Electric.

G-E Research works continually to develop new materials, new processes, new applications for plastics.

G-E Manufacturing Facilities are available for all types of plastic parts—for compression molding, injection molding, transfer molding, extrusion molding, cold molding, both high and low pressure laminating, and fabricating.

EVERYTHING IN *Plastics*

BUY VICTORY BONDS AND HOLD THEM

GENERAL ELECTRIC

CD41A-1